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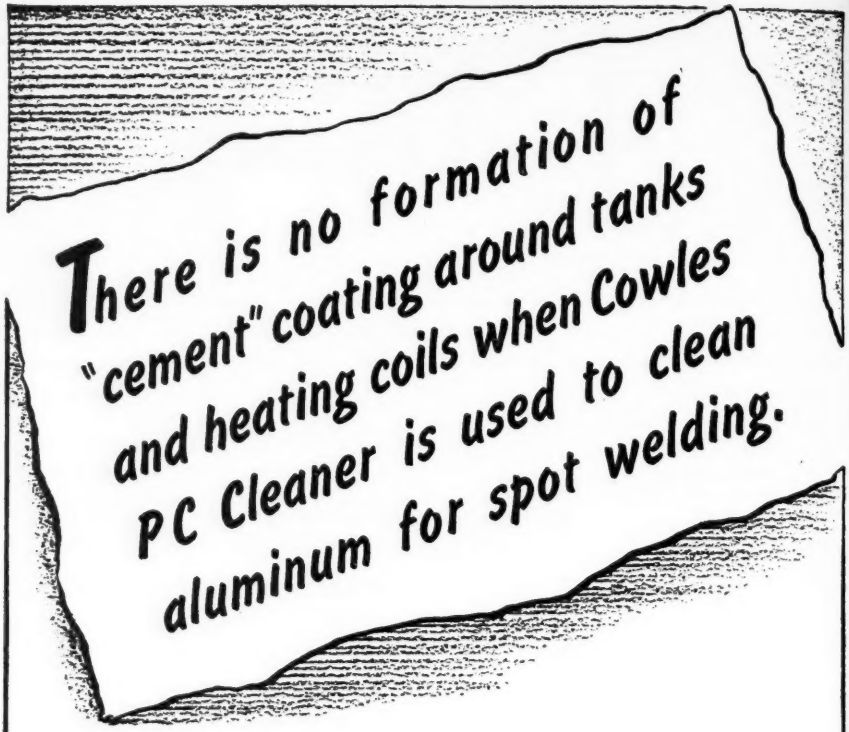
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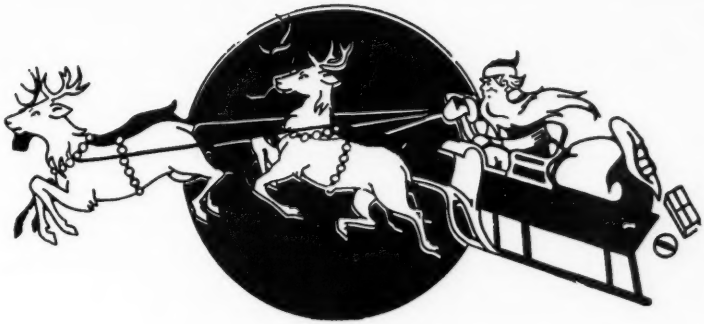

AS the eventful war year 1942 draws to a close we have the opportunity once again to send our good wishes to the thousands of friends of PRODUCTS FINISHING. The past eleven months brought new problems to every metal finishing plant and department but thru the cooperation of the manufacturers in this field and the cooperation of the readers of this magazine many of these problems were solved with expediency.

We now look forward to the approaching year with a renewed confidence that the contributions of both manufacturer and reader will aid immeasurably toward ultimate victory. And so during this yuletide season those on the staff of PRODUCTS FINISHING send good wishes to you.

Hot Spots Cause Short Hot-Dip Galvanizing Pot Life

This article explains that uniform heat distribution is the secret of a long galvanizing pot life

By WALLACE G. IMHOFF
President, The Wallace G. Imhoff Company
Vineland, New Jersey

THE failure of the hot-dip galvanizing pot even in normal times is a very serious matter; the early failure of a galvanizing pot in war times like these is a disaster. Both zinc and plates are vital materials in the war effort; increasing the life of the galvanizing pot only saves plates but also zinc. The purpose of this discussion is to clearly show that uniform heat application to the galvanizing pot sides is a major factor in lengthening pot life. Any factor which tends to concentrate the heat on small areas with excessive temperatures, is a vital cause of pot destruction.

What Are Excessive Temperatures?

Many articles have been written discussing the relation of galvanizing bath temperature to pot destruction. It has been conclusively demonstrated by research investigations that at temperatures above 900 deg. F. the alloying action between the zinc and iron is very much more active than at temperatures under below 900 deg. F. This fact may be well known and carefully observed by the galvanizing foreman in galvanizing operations, but a poor galvanizing furnace design may develop areas of high heat concentration, or "hot spots" as they are called, even when heating the bath to temperatures below 900 deg. F.

Many galvanizing baths have been observed in practice that were far below 900 deg. at the top, but down at the bottom in the heating area tests have shown temperatures well above 900 deg. F. Since the outbreak of the war many deep pots have been installed which makes it even more difficult to obtain a uniform distribution of the heat over the entire heating area, and when the heat is not applied uniformly it means that some areas have too little heat, while others may have far too much. The areas overheated show excessive temperatures, and excessive temperatures bring about quick destruction of the pot.

The average standard depth of galvanizing pots for the past twenty years has been 48 inches (4 ft.); a few have been less than this figure, and a few over it. The reason for the in-

crease in the number of deep pots, up to 5, 6, 7, 8, and 9 feet, is due to the enormous increase in ship work. Pots for galvanizing ship plates always have been deep, but there were only a few of them. The vast ship building program has been the cause for the demand for many more big deep galvanizing pots.

Factors That Determine the Size of the Pot

It is just common sense to use a galvanizing pot large enough to easily take the largest size of article to be galvanized. That is the first factor in determining the size of pot to use. But there is another factor of equal importance which also must be very carefully considered, and this second factor is production in pounds per hour to be put through the bath.

When these first two factors are definitely known, two more vital factors can be figured out. These are the correct metal capacity of the pot, and the proper side thickness. It is important to know the right side thickness in order to obtain the maximum life of the pot under all conditions of internal corrosion and dissolving action of the molten zinc upon the sides, and also for mechanical strength to avoid bulging of the sides. Premature pot failures have been found because the sides have been far too light, and one case was encountered where the pot side perhaps was too heavy.

Total Heat Input Required Per Hour

If hot spots are to be avoided the heat input must be distributed uniformly over the entire heating area. Many years of practical experience have established the fact that to obtain a three-year pot life, or longer, no more than 8,000 to 10,000 heat units must pass through each square foot of heating surface of the pot. The total heating area is quickly obtained by multiplying the length of the side by the depth of the side. However, when the furnace is built

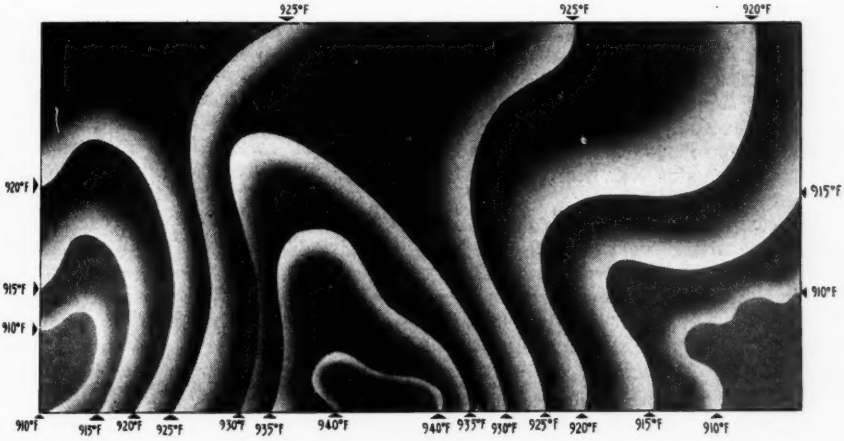

Fig. 1—Diagram showing heat distribution over the side of a coke-fired galvanizing pot. Note: Readings taken inside the pot against the side.
Firebox Temperatures:
First Test Between 1200 and 1980 Deg. F.
Second Test Between 1060 and 1450 Deg. F.

some of this total area is not heated; the ratio is 60 to 70 per cent for the area actually heated.

Since the production in pounds per hour is known, the total heat to be supplied can be quickly obtained. This figure should be at least double, since few hot-dip galvanizing furnaces are 50 per cent efficient. The actual heating area of one side must also be doubled, since heat is applied to both sides of the pot. The total heating area in square feet divided into the total heat required for the production in pounds per hour will then give the amount of heat that passes through each square foot of heating area. This should be 10,000 B.t.u.'s, or under to give an estimated galvanizing pot life of three years or over.

Fuel and Combustion Requirements To Give Long Pot Life

Just a few of the factors that eliminate hot spots on galvanizing pots have been discussed, but even these are by no means all of them. They tend to give the correct pot size to handle the work in, but this engineering is only a part of the furnace engineering. The kind of fuel used is a vital factor in galvanizing furnace design. The old coke-fired furnaces allowed the fuel, or coke in the combustion chambers to lie right up against the side of the pot as it burned.

In order to get air to the fuel, channels were made in the fuel bed by poking a heavy steel rod down through the fuel and then churning it around to open up an air passage. Improved designed supplied air ports half way up the side of the furnace, and the draft control was operated by putting in and taking out half bricks in the port holes.

Modern galvanizing engineering practice absolutely prohibits any fuel of any kind to touch the galvanizing pot sides, or any products of combustion of any fuel to directly impinge on the pot anywhere. This idea is for the purpose of eliminating hot spots, or areas of high heat intensity on a small area of the pot side. The prime reason is to obtain a uniform heat distribution over the entire side of the pot, with every square foot of heating surface getting as near as possible the same heat through it as every other square foot of heating area.

The subject of heat intensity is also another factor that modern combustion engineering of galvanizing furnaces has brought under control. Fuels like gas and oil, and especially oil, could bring up a very large fuel supply in a very short time. Also the fuel itself not only has a very high heating value, but the heat content can be quickly delivered. This is a very great material advantage over the slow burning coke fuel, but when not handled right, the advantage is turned to a big disadvantage by creating such a high heat intensity that the pot is quickly destroyed.

Modern engineering practice retains the advantage of the flexibility of the fuel, and also its high heating value by splitting it up into very small delivery parts. Burning a large volume of fuel through a few outlets requires a high pressure blower and a large amount of air to burn all the fuel. Doing this in a short time develops an enormously high heat intensity. Actual cases have been where the heat developed was so high that it melted the brick in the combustion chamber.

A high heat intensity is always a dangerous thing in a galvanizing furnace because galvanizing is a low temperature operation. To develop 3,500 deg. of heat when only 850 to 900 are required is obviously the wrong kind of combustion engineering. The answer is to increase the number of fuel outlets (burners) and deliver the same total amount of heat

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at a low heat intensity, burning a small quanitity of fuel from a small burner. The modern technique of using a large number of outlets and burning the same amount of fuel at a low heat intensity creates what the writer has called "short range combustion."

In contrast to the earlier "long range combustion" in which the flames have actually been seen to be burning out of the top of the stack, this modern practice shortens the flame of combustion, keeping the burning of the fuel entirely confined inside the galvanizing furnace proper. This tends to greatly increase the combustion efficiency and make a great saving in fuel, since only an absolute minimum of heat is lost to the stack.

It is easy to visualize an automobile with the four wheels all of different sizes. There can be no argument as to how it would run. It is not so easy to visualize an unbalanced galvanizing furnace. In order to explain what an unbalanced galvanizing furnace is we will describe a perfectly balanced galvanizing furnace as one which if an imaginary line be drawn through its center, one-half of the furnace will be an exact mirror image of the other half. This includes the stack.

A perfectly balanced furnace will be the same on each side in burners, flues, and fiiring. This gives equal draft pull, and should develop the same heat, supply the same fuel, and in every condition be the same on both sides of the furnace. One of the commonest conditions found in unbalanced furnaces is the wrong location of the stack; one flue is short and the other long.

Operating Requirements to Avoid Hot Spots

No galvanizing furnace is perhaps perfect. Any defect in furnace design or construction will, therefore, be magnified under wide variations of operating conditions. The furnace is carefully designed and built to take a certain production load. A factor of safety of at least 25 per cent is in most all cases taken into consideration. The ideal operating performance is then a uniform production in pounds per hour, every hour, and with a production that will not take out more heat from the bath than is put in.

The ideal performance is obtained when the temperature of the bath runs along a straight line at 840, 850, or whatever the right bath temperature is for both quality and production schedule. This condition is obtained with a uniform production perhaps all day long on a single article. The other extreme, and the one to be avoided as much as possible, is changing the product often, increasing or decreasing the production in pounds per hour radically, and setting up conditions generally that cause wide fluxuations and variations in the bath temperature.

A general rule to follow is that very large pots should operate at a bath temperature that is constant both day and night, and as the pot grows smaller the bath temperature gradually becomes more flexible. The ideal condition, however, even in small baths is to operate with as little temperature variation as possible and practical. Uniform heat application tends to prolong the pot life; wide fluxuations of bath temperature and heat application tend to give a short pot life.

Some years ago Eugene Hallock, Chief Engineer of Republic Metalware Company, Buffalo, N. Y., made a heat distribution survey over the side of a coke-fired hot-dip galvanizing pot. The results of this survey are shown in Fig. 1. The readings were taken inside of the pot against

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the side. Temperatures that were the same were then all connected, giving the complete picture of heat distribution over the side. We are particularly interested in the hot spot seen at the center at the bottom of the pot. It has been previously stated that a temperature of 900 deg. F. was the danger limit, and this survey shows every part of the side over the danger limit temperature.

At a later date the writer made a very careful study of another 16-foot galvanizing kettle that failed after being in service only three months. Some very valuable facts about the policy of buying galvanizing kettles was obtained in an interview with the purchasing agent. Their pots had been lasting a year or more. At that time the side thickness was 1¼ in., which is almost a standard side thickness for all small pots.

As his knowledge of galvanizing pot failures increased he got the idea that by increasing the side thickness he could increase the pot life, so the thickness was increased to 1⅜ inches and a better life resulted. Working on the same idea, the next pot was ordered with 1½-inch sides, and from then on each pot had a thicker side until the pot in question had reached a side thickness of 1⅞ inches. This pot lasted exactly three months to the time of failure.

In order to study the heat application in this hot-dip galvanizing pot, actual samples of the pot zinc-iron alloy were taken from the inside wall right down to the hole in the side which clearly could be seen to be the hottest spot. This example is really an ideal sample case to show that hot spots are the direct cause of short pot life, and that a uniform heat distribution over the entire heating area is a condition that tends to greatly increase the length of the pot life. This example also illustrates the principle that direct contact of the pot side and the fuel should be avoided.

While the example illustrated at this time is a coke-fired furnace, the same general principles hold for all fuels, namely, that the fuel itself should not burn in direct contact with the pot side, nor should the products of combustion of gaseous fuels impinge directly against the pot side. This illustration is not only a perfect example of the destruction of the galvanizing pot by high heat concentration on a small area, but it also clearly shows the effect of increase of temperature on the alloying action on the pot, and on the development of the zinc-iron alloy.

The actual mechanism of pot destruction can be seen from start to finish through every degree of heat intensity. A very interesting and practical sidelight was the comment by the purchasing agent that the reason the pot burned out was because the side was too thick, and in driving enough heat through it for galvanizing operations a hole was burned in it. However, this does not alter the fact that the scientific cause of the failure was a "hot spot," meaning, of course, that far too much heat was concentrated upon the one very small area.

A very clear understanding of just what has happened in the failure of this galvanizing kettle can be had by referring to two articles which discuss the diffusion of zinc and iron. The first was a paper, "The Diffusion of Zinc and Iron at Temperatures Below the Melting Point of Zinc" by Gilbert Rigg, presented to the Institute of Metals, at the Annual General Meeting, London, March 7, 1934. (Vol. LIV, No. 1, 1934.) The second paper is one by the writer which was published in PRODUCTS FINISHING, January, 1939, and the title was "Diffusion of Zinc and Iron at Temperatures Above the Melting Point of Zinc." Both papers are well illus-

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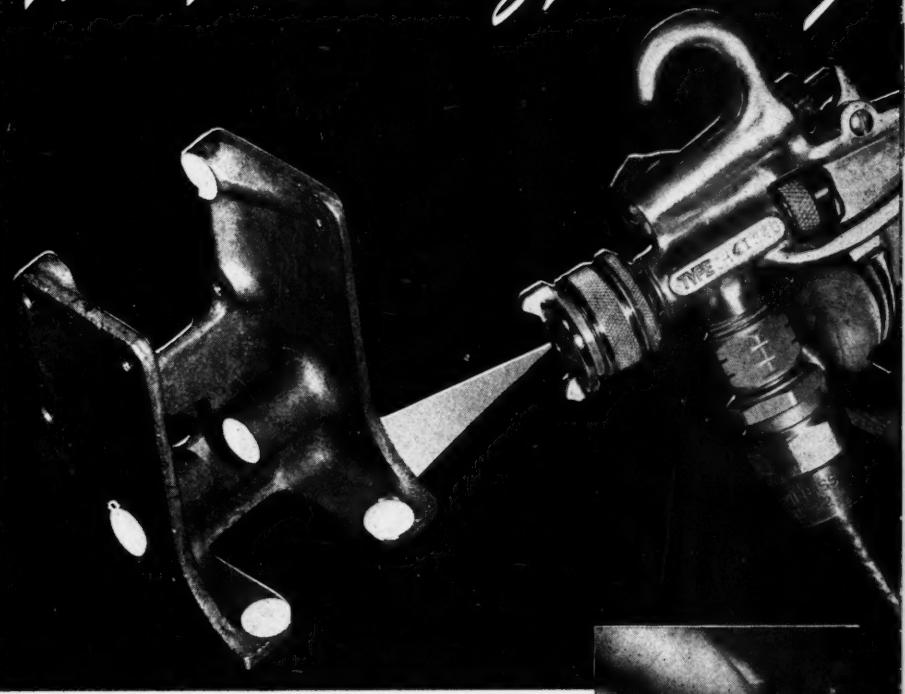

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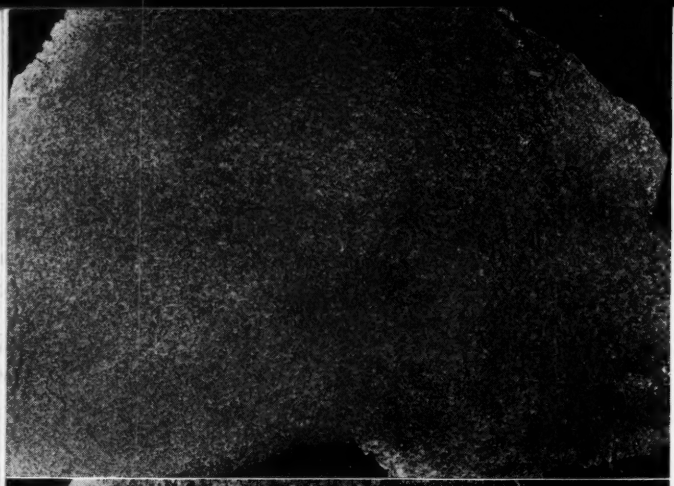

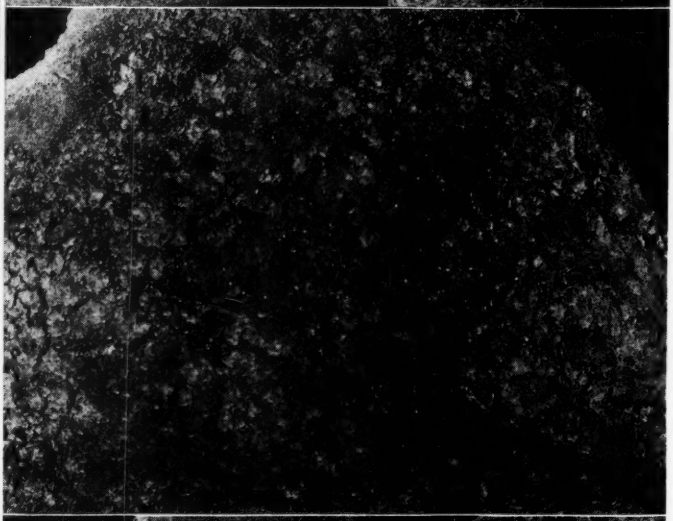

Fig. 2—(Left)—Zinc-iron alloy from the steel side of the galvanizing pot about 8 inches down from the top. Temperature about 800 to 850 deg. about 800 to 850 deg. F.
Fig. 3—(Left Center)—Zinc-iron alloy from the steel side of the galvanizing pot about 16 inches down from the top. Temperature about 850 to 900 deg. F.
Fig. 4—(Left Bottom)—Zinc-iron alloy from the steel side of the galvanizing pot about 24 inches down from the top. Temperature about 900 to 950 deg. F.

trated, and fit in perfectly as a background to reading and understanding perfectly this pot failure.

It has been mentioned that the thickness of the side was 1⅞ inches. At an average temperature of 850 deg. F., with uniform heat distribution over the heating area, an expected life of at least three years could be looked for. With a temperature of 1,100 deg. F. on the other hand the expected life is only 60 days. Since the pot actually failed in about 90 days, it can be assumed that the temperature on the hot spot was

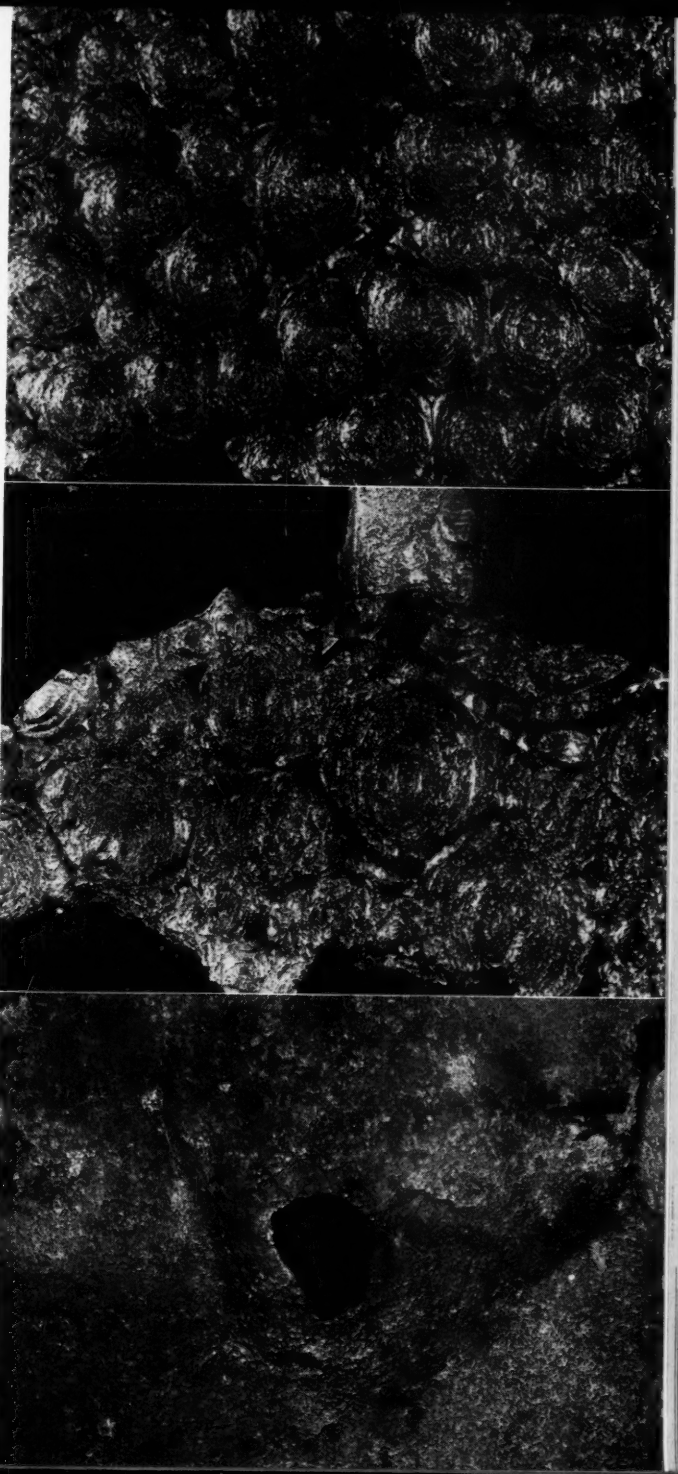

Fig. 5—(Right)—Zinc-iron alloy from the steel side of the galvanizing pot about 24 to 30 inches down from the top. Temperature about 950 to 1000 deg. F.

Fig. 6—(Right Center)—Zinc-iron alloy from the steel pot side of the galvanizing kettle from 36 to 40 inches down from the top. Temperature about 1000 to 1050 deg. F.

Fig. 7—(Right Bottom)—Hole in the pot side about 40 inches down from the top. Temperature about 1050 to 1100 deg. F.

continually at about 1,050 deg. F. These figures not only correspond to the iron loss of the pot side at these temperatures, but also are verified by other data such as the character of the zinc-iron alloy formed.

Figure 2 shows the character of the zinc-iron alloy taken from the inside of the pot at the top, and about 8 inches down. The important feature of interest is the expansion of the alloy, causing the surface to be filled with cracks and fissures in every direction. The texture is much like that of snow — open and very porous. At-

tention is directed to the fact that the conditions described in all of the plates are developed as a result of cooling. Temperature, 800 to 850 deg. F.

Figure 3 shows immediately the effects of a higher temperature on the zinc-iron alloy. This piece of alloy was broken off the pot side at about 16 inches down. The temperature was about 850 to 900 deg. F. The most important feature in this alloy is at once seen that the cracks have become very much larger, and the alloy seems to be forming "cakes." Some of the cracks are very wide. The alloy is bulged due to the expansion condition set up by cooling. The appearance on the surface greatly resembles the hide of an elephant.

Figure 4 shows the under side of pieces of zinc-iron alloy broken away from the pot side down about 20 to 24 inches. Two very striking features stand out; namely, first, the areas are distinctly taking on a more or less circular form; and second, the edges are white due to the formation of zinc-iron alloy. A third feature of importance is that the circular areas seem to be separate from each other as though some force were giving each circular area its own individual form. A fourth feature is seen in the zinc penetrating inward into the circular areas. A fifth feature is the weakening or breaking down from a solid area to one of many small circular areas.

The thickness of the alloy is seen to be a little over ⅛ inch. It is very hard and brittle and tends to break up into the small circular areas. In other words, the alloying action at the outside of the circular areas has greatly weakened the main piece so that it readily breaks up into many smaller pieces. There first seems to be a penetration lengthwise in strips which again tend to break up into small circular areas. The temperature at this point is from 900 to 950 deg. F.

Figure 5 shows the effect of a higher temperature very plainly. The striking features observed at once are the clusters of individual alloy units. These have taken on an appearance of many circles inside of a form which in some units is a perfect six-sided outline, or hexagon. Considerable space is seen to exist between the units. The perfect hexagon outline can be seen in the unit at the lower right-hand corner although almost all of the units show this form. The thickness of the alloy is seen to be over a quarter of an inch. The temperature is about 950 to 1,000 deg. F. This piece of alloy was broken off from 24 to 30 inches down on the pot side. The drastic effect of temperature is seen at once by comparing Figures 1 and 4.

Figure 6 shows the zinc-iron alloy about 36 to 40 inches down, in the vicinity of the pot failure. The temperature is about 1,000 to 1,050 deg. F. The zinc-iron alloy is ¾ inch thick. The significant fact is that the zinc has penetrated completely to the center as shown in Fig. 5. The main difference is thickness of the alloy formed. All units have the distinct hexagonal outline form. The circles get smaller and smaller to the center. A clue as to what is going on may be found in the cross section of this piece of alloy. A careful look at this piece of alloy shows alloy cones penetrating outward from the steel plate. The pot side is at the right and the bath at the left of the piece of alloy. Rigg gives the analysis of his cones as from 10.6 to 13.5 per cent iron content.

The writer analyzed six cones broken off a sheet in a research investigation and found they averaged only 4.24 per cent iron content. Rigg's experiments were made with a sheet of zinc between iron plates; the writer's experiments were made with an

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iron sheet in a zinc bath, exactly opposite from Rigg's conditions. It would be expected, therefore, that Rigg's cones would be higher in iron, while the cones of the writer would be higher in zinc content (lower in iron content).

Figure 7 shows the hole in the pot side. All illustrations are full size just as found in the pot side and alloy pieces. The temperature here is about 1,050 to 1,100 deg. F. The hole is about 36 to 40 inches down on the pot side. Here is the complete picture shown vertically that temperature has had on the pot side. It is a perfect example of a "hot spot," or the high concentration of heat on a very small area.

Attention is particularly called to the hexagon form around the hole. Another small hexagon is seen at the right just a little above the middle of the plate, and a very large hexagon can be seen at the left. The sides of the hexagon around the hole also form the same side of the other two hexagons at the right and left.

Here is a perfect verification of theory in practice. The writer has developed these cones in the laboratory and also developed the zinc-iron alloy which has the outline of a hexagon. The evolution appears to be first the development of the cone which later on develops into a hexagonal pyramid of the first order. The pyramids are made up of piles of hexagonal plates, each one getting smaller until the apex is reached.

Summary

It has been very clearly demonstrated that a "hot spot," or an area of high heat concentration on the pot side will quickly corrode a hole through it. The progressive destruction of an actual galvanizing pot in practice has shown this fact to be true.

Vital Facts About Hot-Dip Galvanizing Furnace Design

1. The size of the largest articles to be galvanized.
2. Production desired in pounds per hour.
3. The metal capacity of the pot.
4. The side thickness of the pot.
5. The total heat input per hour.
6. Heating area 60 to 70 per cent of total area.
7. B.t.u.'s per square foot of heating area.
8. Fuel must not touch sides of pot anywhere.
9. Fuel supply must be divided into small units to give low heat intensity.
10. There must be "short range" combustion.
11. There must be balanced combustion.
12. There must not be wide fluxuations of bath temperature.
13. Production must be put into the bath as uniform as possible.
14. The pot should be kept clean of dross, and the dross should never be allowed to accumulate over 8 inches.

If all of these items are taken into account and carefully studied, the pot life should be at least two to three years, and intelligent operation and supervision may extend it much longer. All furnaces should be equipped with automatic temperature control equipment, and temperature recording charts.

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Formax Folders. Three inserts presenting a graphic picture of the Formax buffing, burring and polishing service are now being issued by Formax Manufacturing Company, 3999 18th St., Detroit, Michigan.

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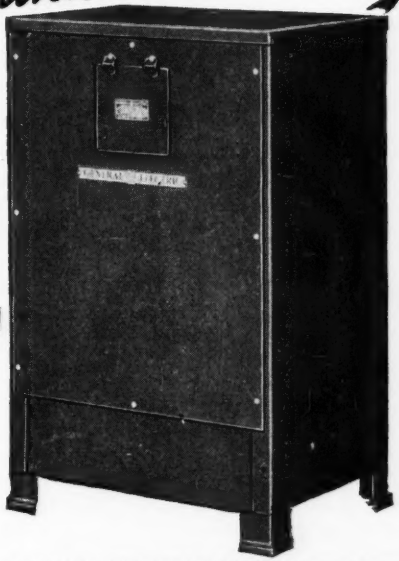

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GENERAL ELECTRIC

Durable Finishes Important on Heavy-Duty Machines

By WILLIAM C. REINHARDT
Plant Superintendent, Racine Tool and Machine Company
Racine, Wisconsin

A QUALITY finish in the case of heavy-duty machinery may not seem important to the layman, who is apt to think that sturdy construction and efficiency are the chief requirements. The industrialist, however, appreciates the value of good finish on all shop equipment, knowing that it not only enhances the general good appearance of the shop, which rates high when it comes to psychological effect upon workers, but that it also adds to the long wearing qualities of the machine itself.

At the plant of the Racine Tool and Machine Company, Racine, Wisconsin, particular attention is given to the finishing of the various castings entering into the construction of power hack saws, of which the company has been a designer and builder for more than thirty years, and which now are playing an important part in the furtherance of the war program, being used at many of the army, naval, and air bases, on shipboard—battleships and cruisers—as well as in many of the plants of the heavy industries.

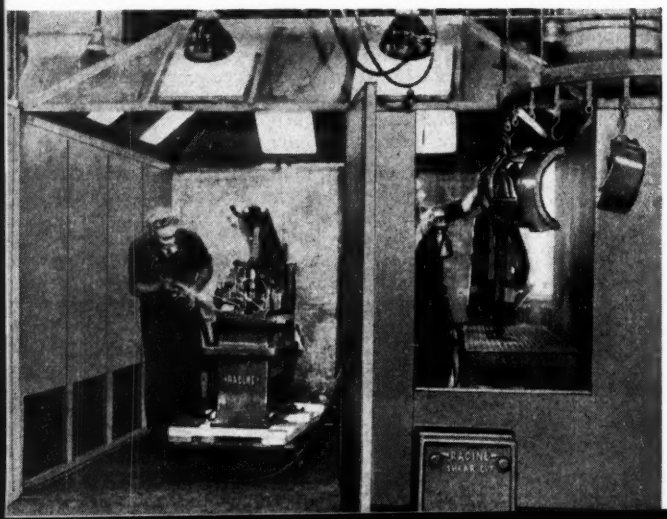

Fig. 1—View of spray booth, showing method of handling single castings as they pass along on conveyor, as well as assembled machines on skids and floor trucks.

The heavy castings of heads, bases, tables, guards, saw frames, saw guides, motor brackets, and other parts, are

delivered as rough castings to the plant, whereupon they are sent to the grinding department. Here in a well lighted and well ventilated room, they are ground with cup wheels of P-8 grade, 020 grain mounted in a portable flexible machine, readily moved about from one side of these large castings to the other, compressed air being used for blowing off any dust accumulations. The castings are then sprayed with a prime coat of red iron-oxide and allowed to dry over night. The next day two coats of iron filler are applied. This filler is first brushed on in the form of a heavy paste, and then smoothed out by going over the surface with a brush dipped with naphtha. After another overnight drying period the casting is ready to be sanded.

All sanding is done by hand, using a No. 80 paper for the rough sanding followed by the use of No. 150 for the finish. The sanded parts are then sprayed with a machine tool gray sealer coat as they pass through a down-draft spray booth, cup guns being used exclusively for spraying. The spray booth—12 ft. x 12 ft.—in one corner of the finishing department, is equipped with motor driven suction fans, one on each side, which draw the fumes out through the bottom at each side of the booth and pulling the air in the booth downward and then upward behind a partition and on through stacks exhausting beyond the roof of the building. The booth is well lighted from eight flood lamps, two on each of the four sides.

When ready for the sealer coat, the castings are hung on hooks suspended from an overhead traveling chain conveyor which passes through the booth and then along the farther side. This conveyor may be regulated to any desired speed to accommodate the size of the pieces to be painted. After spraying, the pieces pass out of the

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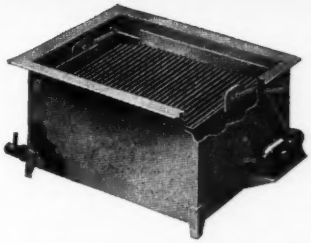

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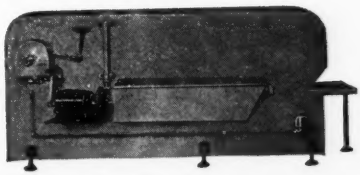
This small, compact, automatic and mechanically simple unit combines the two most positive methods of cleaning Metal Parts, Assemblies, Shells, Cartridges, Castings, Stampings, etc. A swishing action positively removes all grease, oil, dirt and metal chips that have been loosened during the "chemical action" of the "soak." Can be installed in different departments or in a series—one unit for cleaning, another for rinsing or rust prevention coating and others for special requirements. Send for "Simplex" bulletin for complete details.



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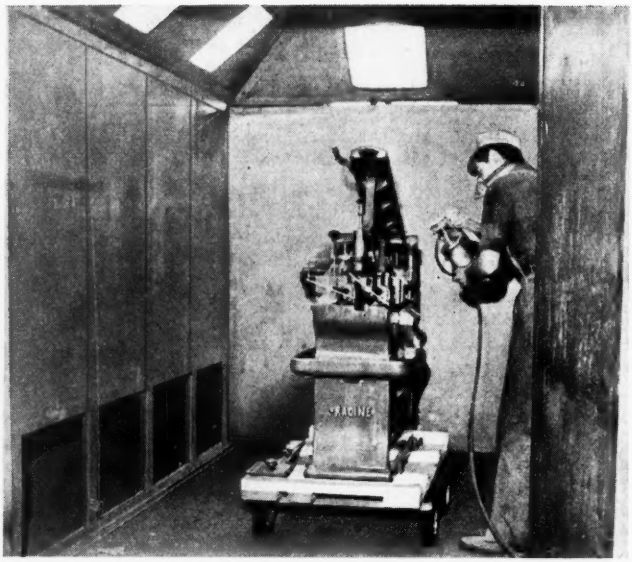


Fig. 2 — Illustration showing heavy machine being finished in fully enclosed spray booth of modern design.

booth and around to one side, where they are left hanging until dry, after which they are removed from the conveyor and sent to the assembly department.

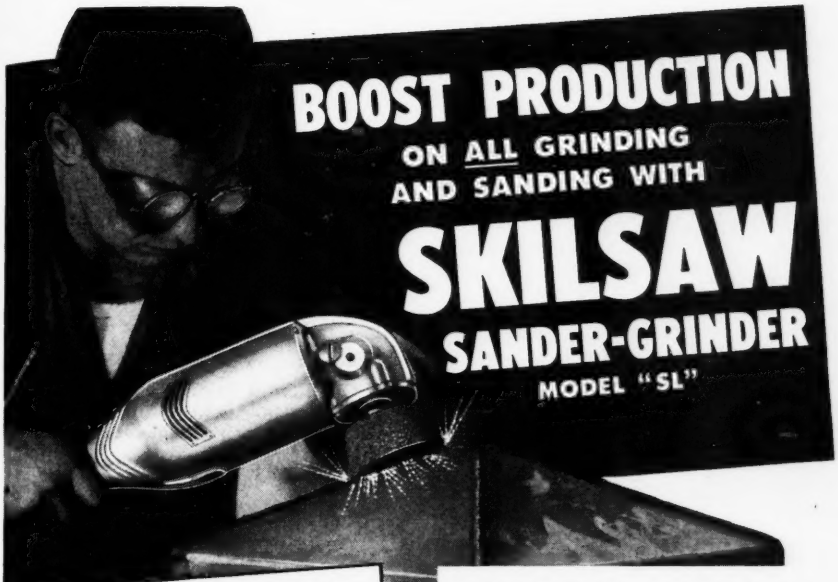
The assembled machines, bolted to wooden skids on which they remain and which later constitutes the bottom of the shipping crate, are returned to the painting department riding on lift trucks, where they are prepared for the finish coat. First all previously painted surfaces are hand sanded with No. 150 paper and washed thoroughly with naphtha. Any scratches or blemishes are filled and smoothed with lacquer spot glaze. The machine, still on the lift truck, is then taken into the spray booth and given a finish coat of machine tool gray enamel. After a drying period of about two hours, it is ready for crating and shipping. No masking is used, since any paint spots on the table top or other machined surfaces is wiped off immediately after the machine leaves the spray booth.

Lettering, such as the trade name "Racine"; the name of the company; and some control and maintenance instructions, are raised in the various castings. These are hand painted with aluminum. When thoroughly dry, and just before sending the machine to the crating room, all surfaces not protected by paint are coated with a rust resistant compound.

New Plant Sanitation Manual. A new, 16-page illustrated manual now being published by Oakite Products, Inc., 20 Thames St., New York City, discusses effective, wartime sanitary measures and "good housekeeping" routines for use in steel mills, foundries, metal-working plants, and so forth. It tells how Oakite Deodorant No. 1, a recently developed three-purpose sanitation material cleans, deodorizes and disinfects cement, poreclain, metal, tile and wood surfaces in a single operation.

Among the distinctive features of this unusual material is its ability to destroy and neutralize a wide range of offensive odors. Being odorless itself, it does not mask one odor with another. The manual contains performance-proved recommendations for maintaining washroom floors and woodwork, wash basins, urinals, toilet bowls and seats, wash fountains, lockers, and so forth, in a clean, odor-free sanitary condition.

Copies of the manual are available upon request.



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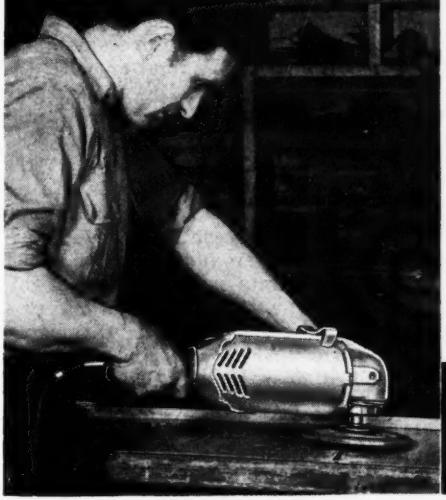

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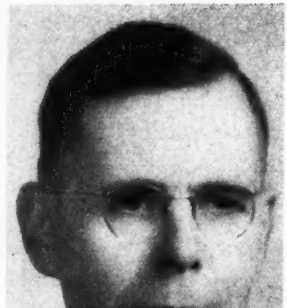

Rust Control In Wartime

By GEORGE H. PIMBLEY
General Superintendent
International Rustproof Corporation, Lakewood, Ohio

MANY metal industries are today faced with the very urgent problem of corrosion. Steel, in the form of armaments and machinery, is being transported to all parts of the world, under all kinds of atmospheric conditions, ranging from high humidity in the jungles of New Guinea and the South Sea Islands to the dry, arid climate of the Libyan desert, or to climates where the temperature in winter will be far below zero. If these supplies are to be safely delivered and used by our armies and those of our Allies all over the world, it is obvious that they must be thoroughly protected against corrosion. In this article we consider it more expedient to confine our discussion to steel, inasmuch as it is this metal with which we are principally concerned in the war effort.

To begin with, we must, of course, visualize steel, not as a simple element, but as an aggregate comprising many substances, among which iron is the predominant one. For example, in the so-called "stainless steels" there are considerable amounts of such presently critical metals as copper, chromium, nickel, and so on, which prevent the rusting of the steel, therefore, such steels are removed altogether from our discussion. In a simple open hearth steel, the iron will amount to 99 per cent, the remainder consisting of small amounts of carbon, silicon, sulphur, phosphorous, and so on. All these minor constituents are present in various forms, in combination with the iron and with each other. They give rise to varied physical structures, quite often in crystalline form.

It is apparent, therefore, that the surface of a piece of steel is a composite of dissimilar substances and physical structures. Wet a steel surface with water and you have all of the components necessary for a galvanic cell with the exception, perhaps, of an electrolyte in the water. Even the electrolyte can be readily supplied by a trace of sulphur fume absorbed from nearby industrial or railroad smoke stacks; or from combat explosion fumes, from sea air, or by the carbon dioxide normally pres-

ent in all air. In other words, with a drop of water on the surface of ordinary steel we have a small electric battery which can cause small currents to flow from one point to another. All of the facts of corrosion[1] can be explained upon this basis; and the adequate prevention of rusting can be worked out upon the same basis.

In every electrical system such as we have described, we have the condition of something being dissolved at one point and going into solution in the liquid phase of the system; whereas at an opposite point (in our case, some adjacent point on the surface), something leaves the liquid and is deposited on the electrode. In the case of our minute electric cell, on the surface of the steel, the most easily soluble substance will be the simple element iron, and the opposite electrode may be a spot of iron carbide, which is very inert and resists solution. A small amount of electric current flows from one point to the other, and consequently we will have iron dissolving readily and forming ferrous hydroxide solution in the water. (Hydrogen gas is deposited on the iron carbide electrode point.) As soon as a drop of water becomes loaded with ferrous hydroxide it precipitates out. When the air comes in contact with it, the iron hydroxide changes to iron oxide, which is the familiar reddish brown substance that we call "rust."

Phosphates Aid Control of Rust

Having thus established a reasonable theory as to how corrosion can occur on a steel surface, we can determine what should be done toward its prevention. That leads us to con-

[1]*The expression of the electrolytic theory of corrosion used in this article is derived from lecture notes by Prof. C. F. Prutton, Head of Chemistry Department, Case School of Applied Science.*

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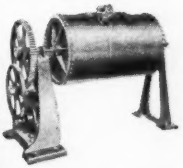

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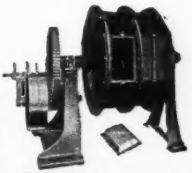

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sider the rate of corrosion which, in turn, depends upon the rate of solution of the iron, and which is in proportion to the amount of current passing from point to point on the surface of the metal. Now the amount is directly proportional to the voltage, and inversely proportional to the electrical resistance. Therefore, to inhibit corrosion one must either avoid the conditions under which it is possible to have currents flowing from point to point on the surface, or one must place sufficient resistance in the path of the current, as to result in complete electrical insulation.

Considering the first alternative, if it were possible to use only the purest of iron, and to work it so as to have an entirely homogeneous surface, then we would not have points of differing electrical potential, and there would be no passage of current when the surface becomes wet. But we have little choice as to this; mostly we have to take our metal as it comes, and then do our best to protect it. We can, with considerable success, keep water and air away from the surface by means of good paints. This removes, to a large degree, two of the essential factors for the operation of our little electric cell on the surface. We can apply water-resisting oils and resins, such as pheholics, into our paint; or we can use tight, moisture-repellent pigments, or pigments such as the chromates, which have the specific effect of counteracting the electrical cycle previously described. All these measures help a great deal to minimize the occurrence of surface electric currents and consequent corrosion but they are not sufficient.

For more complete protection, we must, in addition, avail ourselves of our second alternative, that is, put a resistance in the path of the electric currents on the surface of the steel, including the side walls and bottoms of all the microscopic pits and irregularities of the surface. This may be accomplished by dipping the metal parts into a hot phosphate bath, whereby the iron surface is converted into relatively insoluble iron phosphate, and also provided with a thin additional deposit of iron and zinc phosphates from the bath. The depth of the phosphate film depends upon the porosity of the metal and upon the time of immersion, which may range from three to thirty minutes. Dimensions of parts are not appreciably altered, inasmuch as there is a simultaneous etching out of iron, and replacement with phosphates. Incidentally, this slight etching puts a "tooth" into smooth steel, which affords a more firm anchorage for paint coatings. The manufacturers who offer these hot phosphate bath processes maintain staffs of engineers to assist in the installation and initial operation. Control is simple, and after getting started right, little difficulty is encountered.

The co-deposit of iron and zinc phosphates is highly resistant to electric currents, thus providing an ideal protection against corrosion as long as it remains unaltered in its position. However, the phosphate film is, to some degree, subject to solution and chemical change by moisture and acid fumes, thus it is not, in itself alone, a complete protection.

The proper place for a phosphate film is under a coat or coats of good paint, preferably a paint primer and a top coat paint. Thus shielded from direct action of air and moisture, the phosphate film insulates against the passage of the tiny electric currents which cause corrosion, and at the same time, firmly holds the paint to the metal. The feature of good adherence is highly important where paint is subjected to extremes of expansion and contraction, from desert sun to Arctic cold. The same paint may go to both climates.

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Paint is the outer shield against sun, water, air, chemical fumes, and so on. Each coating supports the other, and thus we have taken advantage of both our possibilities. We have largely shut out air and water which promote the electrical process of corrosion and we have insulated down into the metal against currents which are generated in spite of the paint.

Another important matter to consider regarding rust control is accidental abrasion. The armament we are making may receive a lot of rough handling which may result in scratching and the removal of paint in spots. In these spots, rust may spread under the paint film unless something is provided to stop it. Eventually, the paint will become loosened and fall off.

A film of phosphates protects against this kind of deterioration in two ways. First, it improves the adherance between paint and steel so that the area of abrasion is minimized. It confines the abrasion to the top coat of paint in many cases, allowing the primer to hold on for partial future protection. Secondly, the phosphate bath process insulates the metal against corrosive electric currents down into the very depths of each pit and microscopic crevice, so that it is impossible for rust to spread further than the boundaries of the abraded area. The scratched or scuffed area itself may rust, even with the phosphate film present but the damage is localized.

In the present war emergency, the phosphate dip processes have another vital use as in the manufacture of bolts, nuts, and other threaded parts. In peacetime, many such articles have not been given any protection against rusting other than oiling because of anticipated quick usage inside, or where they would soon be painted after assembly. For more exacting usage they have been plated with zinc, cadmium, and so on.

Today, the plating metals are critical and are available only to a limited degree, and many of the uses have become more exacting. In some cases transportation overseas will be necessary before assembly. Paint is not practical before assembly, for it would load up the threads, and change the dimensions. One ideal answer is the hot phosphate bath which deposits a protective film on e v e r y thread without appreciably changing the dimensions. After being removed from the phosphate bath parts are given a dip in a good nondrying oil which protects against moisture until assembly. The oil may be wiped off or rinsed away with solvent. Thus is provided an easy, economical method of protection, sufficient for the purpose, which does not interfere with assembly, or require critical materials.

Rubber Conservation.—Containing an illustrated step-by-step procedure for making repairs on conveyor belts by the use of portable electric vulcanizers as one of its principal features, a new booklet, "Rubber Conservation for Users of Industrial Rubber Belting." has just been published by The B. F. Goodrich Company, Akron, Ohio, and is now available upon request to the manufacturer, or this publication.

"How You Can Save Rubber in Your Plant" is the general theme of the booklet, which is divided into interesting sub-headings of the general title, including "Rubber Can Be Saved by Making Vulcanized Repairs Promptly," "Rubber Can Be Saved by Salvaging Belts for Smaller Drives," "Rubber Can Be Saved by the Plylock Splice," and "Rubber Can Be Saved by Proper Care."

Interesting examples of savings already made, and valuable rubber conserved are given. These include the saving of two tons of rubber in a large conveyor belt by making vulcanized repairs and the cutting down of old belts and by removing worn plies, changing them into belts for smaller drives.

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The problem was to remove various types of oil, grease and solvents from steel drums—and to strip paint from these containers. The operation was carried on continuously in a 1000-gallon drum washer at 145 to 155 degrees Fahrenheit.

Several kinds of commercial cleaners had been tried previously, but cleaning was not satisfactory, rejects ran too high and costs were out of line. The method in practice was the use of an initial charge of 400 pounds of flake caustic soda, followed later by an additional 300 pounds.

The Pennsalt representative was able to improve greatly on this with the correct type of Pennsalt Cleaner. The amount required was only about 35% of the caustic soda necessary. The cleaning action was highly effective—the drums dried faster—and grease containers could be included in the cleaning operation, an advantage not previously possible.

What's more—*careful comparison of costs showed that Pennsalt Cleaner was saving this plant 33⅓ percent!*

That's a saving that should interest you, if your plant has a metal cleaning problem. Let our experienced technical staff show *you* how a Pennsalt Cleaner will help you get better results at lower costs. Or write fully to our Pennsalt Cleaner Division, Dept. PF.

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TODAY'S tin shortage has accelerated the development of suitable processing lines for the electrolytic deposition of tin on steel. This process, which has been the object of considerable experimental work for the last few years, has now been taken from the laboratory and made a necessary part of modern steel making practice. Indicative of this progress are tinning lines which are capable of turning out a sheet, tinned on both sides, three feet wide, at the rate of 1,000 feet per minute.

The several types of tinning lines thus far developed have two basic differences. One is whether the speed through the plating bath is held constant or allowed to decrease when a fresh coil of steel is entered into the line. The other principal difference is whether the plating tanks are vertical or horizontal. In one type of mill the steel moves through the plating tanks at constant speed, and means are provided for accumulating enough slack at the entry end to allow the end of a new strip to be welded on. The other scheme, which in general allows a faster speed of strip, allows the entire line to slow down when necessary to start a new

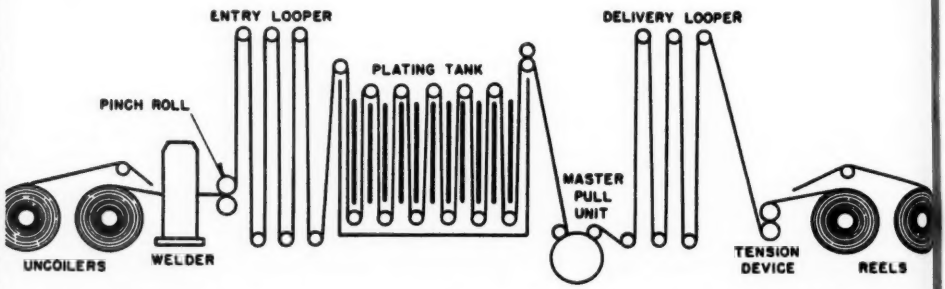

Fig. 1—Schematic diagram of constant plating speed, vertical tank line. The steel sheet is wound in a tight coil up to 36 in. wide and three miles long. This strip threaded through the electrolytic tinning tank and on to rewind rolls.

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Peeps or jeeps are America's automobiles today. Many of the chemicals and processes developed by ACP for pleasure cars are finding grimmer duty now.

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KEMICK is used to develop a coating that withstands red heat on engine exhausts of America's automobiles of today just as it was used to coat these surfaces of the automobile of yesterday. FLOSOL is an ideal soldering flux that wets oily surfaces . . . a most efficient flux for steel, brass, copper, tin, terne plate, zinc and galvanized iron where high-quality soldering is necessary.

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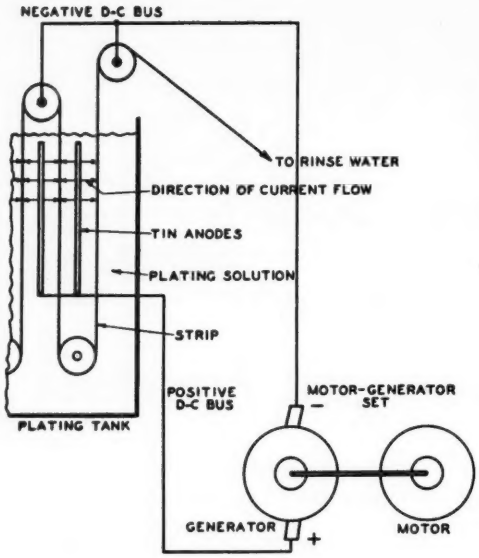


Fig. 2—Tin anodes, submerged in electrolytic solution, are connected to positive side of d.c. bus. Negative bus is connected to steel strip by means of copper rolls and collector rings. The 2500 amperes of current required per anode is supplied by the motor-generator set. As the current flows from the positive to the negative, the tin leaves the anode in ion form and deposits on the moving strip. About 30 millionths of an inch of tin plate is deposited on each side of the strip from the time it enters to the time it leaves the bath.

roll. In the line with horizontal plating tanks the two sides of the sheet are tinned separately, allowing variation in thickness and even in kind of metal deposited, if necessary. In the vertical tank line the sheet is tinned on both sides as one operation and hence exactly alike. To present a clear picture of the problem involved and the associated electrical requirements the two most dissimilar types of lines will be discussed.

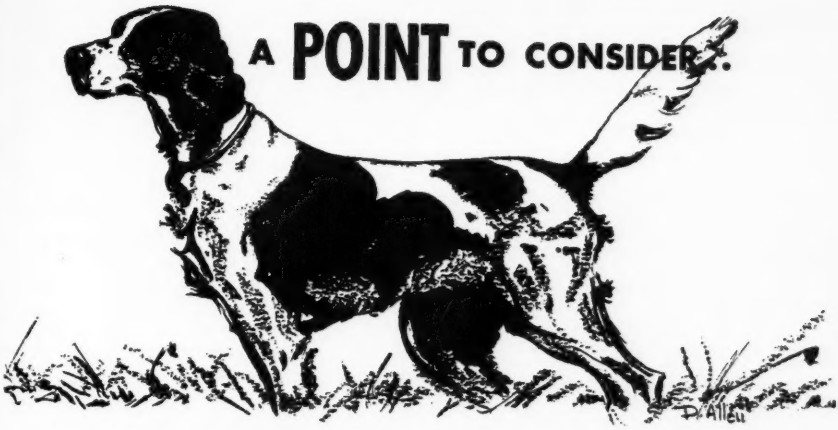
Constant Speed, Vertical Tank Line

Let us consider first the constant plating speed, vertical tank line, as shown in Fig. 1. The steel to be electrically tinned comes to the tinning line in the form of a strip 0.005 to 0.015 inches thick, up to 36 inches wide and three miles long, wound into a tight coil. This coil weighs about 30,000 pounds and is about five and a half feet in diameter. It is placed on one of the two uncoilers at the entry end of the line. The end is then squared in the shear, and is then threaded through the welder and the first pinch roller. From the pinch roll it is threaded successively through the entry looper, the plating tank, the rinse tank, and the master pull unit. The strip is fed through the delivery looper, the tension device, the second shear, and entered on the reel. The line is now completely threaded and ready for operation.

As a processing line of this type is operated from a variable-voltage system, the line is started by increasing the generator voltage until it overcomes the internal drop of the line motors so that the strip just starts to move. The fields of the plating generators are excited. The plating current and the line speed are simultaneously increased, until the desired operating speed is obtained, by properly manipulating the rheostats of the plating generator. A line of this type usually has a maximum running speed of 500 to 600 feet per minute because it does not seem advisable to have several strands of strip running faster than this through loopers who top rolls are at times 30 to 35 feet above the bottom rolls.

Tension Regulator

With the line running we can examine each individual unit to determine what it must do for satisfactory



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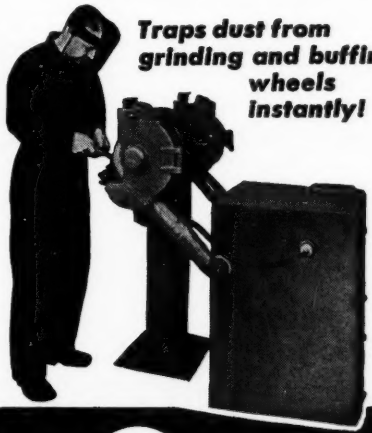

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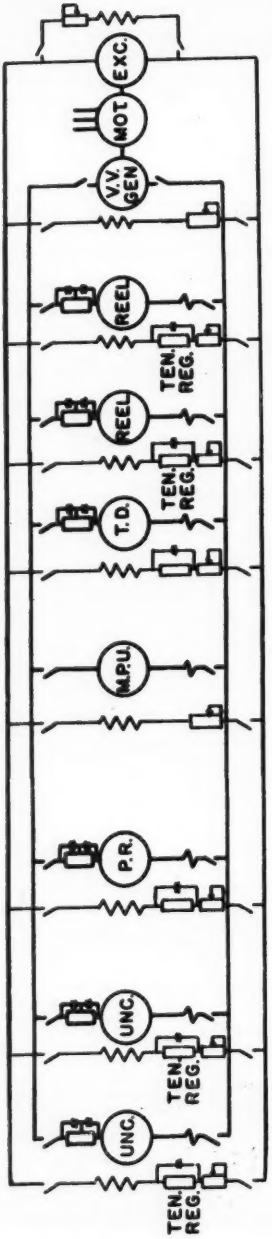


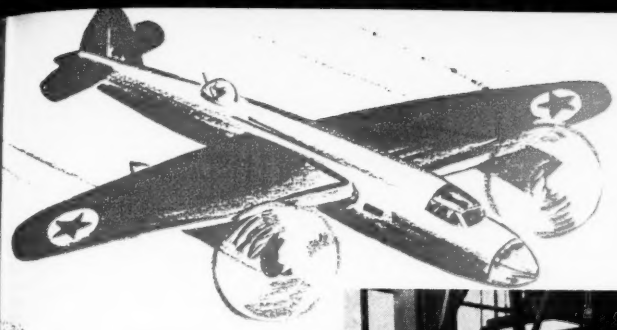
Fig. 3—Circuit diagram of electrical control for constant speed line. In this variable-voltage system, the line is started by the generator voltage until it overcomes the internal drop of the line motors and the strip just starts to move. The fields of the plating generators are excited. The plating current and the line are simultaneously increased, until the desired operating speed is obtained by rheostats of the plating generator.

operation. The uncoiler motor now acts as a drag generator, the steel strip being pulled from the coil against the resistance of the drag generator by the entry pinch roll. To prevent the uncoiler from over-running the pinch roll and allowing slack to accumulate which might cause a cobble or tangle, a tension regulator is used to maintain a light back pull on the strip. A regulator of this type operates on the field of the uncoiler drag generator to maintain a constant armature current. In so doing it also serves a second function, that of automatically compensating for the decreasing diameter (i.e., increasing speed), of the uncoiler.

Both of the loopers, as shown in Fig. 1 consist of several bottom rolls in a fixed support and several top rolls in a movable support. This movable support is counterweighted. The amount of tension in the strip while passing through the plating and rinse tanks is determined by the counterweights. The purpose of the looper is simply to provide a means of accumulating slack in the strip to be used when changing to a fresh roll. When the strip is first started through the line, the field of the motor driving the entry pinch roll is weakened, so that the roll runs about one-fifth faster than the strips through the main compounds of the line. In this manner the entry looper accumulates surplus strip so that the top rolls are nearly at the top of their travel. When this has been accomplished the pinch roll is then driven in synchronism with the remainder of the line.

Tin Thickness Controlled by Current

The plating current is manually adjusted to produce the desired coating weight. In this type of line the anodes of cast tin are supported vertically between the vertical passes of the strip. The negative bus of all plating generators is connected to the



A DOUBLE PASS

LEAROK

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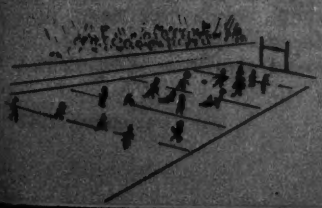

THE "double pass," with LEAROK as the No. 1 man in the pass combination, is scoring many a touchdown in countless war-industry plants working on plastics such as this one making bomber noses of PLEXIGLAS*. It's scoring heavily in plastic plants as LEA COMPOUND, its team-mate, is scoring in not only plastic but metal-working plants.

The point is that LEAROK and LEA COMPOUND plus proper wheels and bobs are the tools with which Lea Technicians are showing manufacturers how to cut polishing, cutting, buffing and burring costs, and how to reduce rejections and work with higher precision.

Lea Technicians have been specializing in this field for many years. They have a wealth of experience to draw upon and a great variety of compounds, wheels and bobs with which to work. Why not let them study your operations and see if they can help you, too, as they helped the people making these PLEXIGLAS* noses for Bombers.

* PLEXIGLAS is the trade-mark, Reg. U. S. Pat. Off., for the acrylic resin sheets and rods manufactured by the Rohm & Haas Company.

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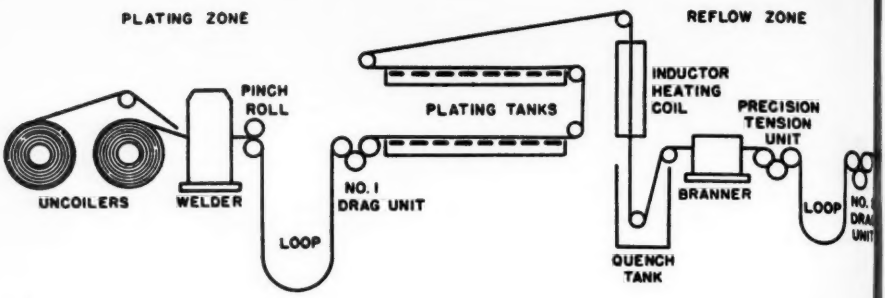


Fig. 4—Schematic diagram of variable speed, horizontal tank line. In this line th
However, an optional delivery, rewinding instead

contact rolls shown at the top of the plating tank illustrated by Fig. 2. The positive terminals of the plating generators are connected either to individual anodes or to several anodes in parallel. The plating current can be supplied from either a low-voltage, high-current, direct-current generator or a dry-type rectifier such as the Rectox copper oxide rectifier. Both methods are being used on lines now being built.

The thickness of the tin deposited or coating weight is a function of both time and speed. Hence, the plating power required is determined by the speed of the line at which a given coating weight is to be applied. Once these two factors have been decided the total plating power requirements can be determined, but this does not necessarily mean that heavier coating cannot be put on or that the line cannot be run at a higher speed. Heavier coatings can be made at reduced speeds while lighter coatings can be deposited at higher speeds. It is essential only that the proper relationship between the total power and the speed be maintained for the desired coating weight.

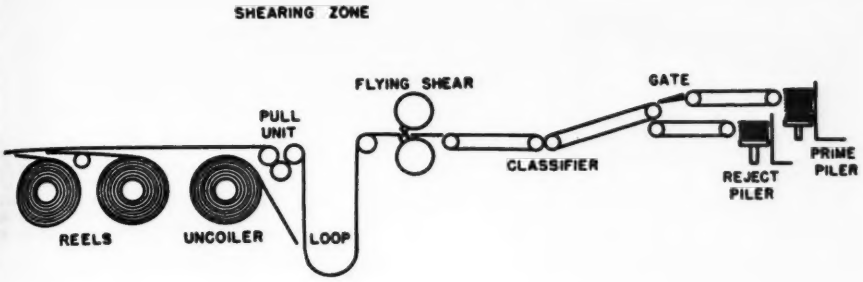
Master-Pull Unit Determines Line Speed

The strip passes from the plating tank to the rinse to remove all plating solution that adhered to it. The strip then enters the master-pull unit. This roll is essentially the master unit of the entire line because the speeds of all the other drives are referred to it. This drive, therefore, fixes the speed at which the strip passes through the line. For this reason it always operates at full-field strength so that its speed is entirely dependent on the applied generator voltage.

From the pulling pinch roll the strip passes through the delivery looper into a tension device. This device operates as a drag generator to insure a tightly wound coil, so that the individual layers will not slip on each other when the coil is handled. Finally the strip is wound into a coil on the mandrel of the reel.

Coils Changed Without Interruption

Another large problem remains for electrical control to solve. When only a few turns remain on the uncoiler the operator accumulates as much strip in the entry looper as possible by speeding up the entry pinch roll slightly. Then when the end of the coil approaches, the entry pinch roll is stopped, the end of the strip sheared off to square it, the end lapped on the new coil, which has been previously placed on the other uncoiler above it, and the two ends welded



electrolytic tinning, fusing and sheeting is a continuous, complete operation. sheeting for the fused tin plate can be employed.

together. During this operation, which normally takes 30 to 40 seconds, the remainder of the line has been operating at normal speed, using the strip accumulated in the looper. On completing the weld, the entry pinch roll is started by a conventional magnetic controller and again operated from the variable-voltage bus. By a similar procedure the delivery end of the line can be stopped to change reels.

Speed Variation Obtained by Armature Voltage Control

The principal advantages of a line of this type are its simplicity of control, the fact that motors of limited range of field control can be used, and relatively low strip speed requir-

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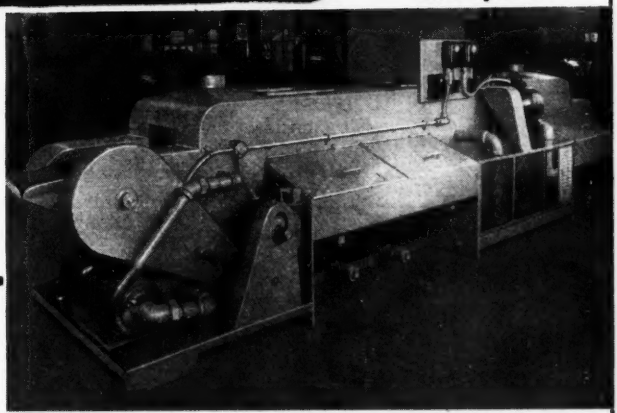

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		DO THIS ONCE EACH YEAR	WILL IT FREEZE?
CARBON DIOXIDE		Weigh to detect leakage. If extinguisher shows loss of weight of less than 10% of rated capacity, stamped on label, nothing need be done. Recharge if weight loss shows greater than 10%.	**no**
SODA ACID		Discharge and refill. Mix soda solution outside extinguisher, following manufacturer's instructions. Use lukewarm, not hot water. Wash all parts with water. Examine for clogging or corrosion.	**yes** Do not keep outdoors in cold weather.
PLAIN WATER		Inspect by removing and weighing carbon dioxide cartridge. Replace cartridge if weight loss exceeds ½ ounce. Inspect hose and nozzle for clogging or corrosion, and check the quantity of water.	Two types available. See label for this information.
FOAM		Recharge. Mix solution outside the extinguisher according to manufacturer's exact directions. Wash all parts thoroughly with water. Test hose. Examine for corrosion or clogging.	**yes** Do not keep outdoors in cold.

NOTE: Recharge extinguishers immediately after use, even though only partially expended.

VAPORIZING LIQUID	**DO THIS ONCE EACH YEAR** Test by partially discharging. Pump a few strokes with extinguisher first aimed upward and then downward. Replace lost liquid, as furnished by manufacturer.	**WILL IT FREEZE?** **no**
DRY COMPOUND	**DO THIS ONCE EACH YEAR** Remove and weigh carbon dioxide cartridge. Replace if it shows loss of weight of more than ½ oz. for 12 lb. extinguisher or 1 oz. for the 20 lb. size. Check quantity of dry compound and determine that it is free-flowing.	**WILL IT FREEZE?** **no**
BUILT-IN CARBON DIOXIDE SYSTEM	**DO THIS ONCE EACH YEAR** Weigh cylinders to check loss of contents. Blow out carbon dioxide lines. Check all releases, thermostats, tubing, switches, pull boxes and electric lines.	**WILL IT FREEZE?** **no**

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*Formerly known as "LUX" extinguishers

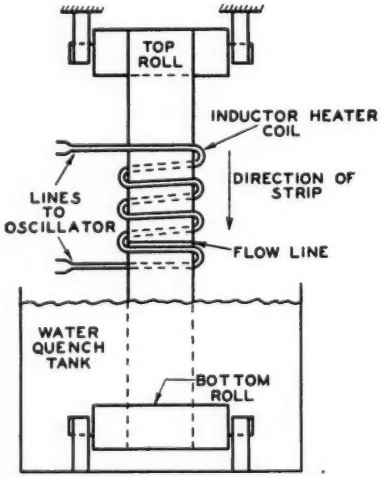
ing only a small amount of driving power. The control is simple, as the electrical schematic drawing, Fig. 3 shows, because once the line is started the speed of the major part of the line remain constant even though at times either the entry or delivery ends are stopped briefly. Practically all the speed variation is obtained by control of the armature voltage. Therefore, it is possible to use motors provided with only a small amount of field control, which makes for a low-cost installation. Only the uncoilers and reels require any appreciable speed range. This is because of the coil changes in diameter.

Variable-Speed, Horizontal Tank Line

The second basic type of line is shown schematically in Fig. 4, and is a high-speed line with horizontal plating tanks and variable-speed plating. This line essentially consists of three distinct units in tandem. These are: first, the plating unit with uncoilers, pinch roll, No. 1 drag roll, and the plating unit; second, the flow or fusion unit with the flow zone, branner, and precision tension unit; and third, the shearing unit consisting of a pull unit, loop, flying shear, classifier, and pilers. This line has been designed for operation at 650 feet per minute, with provision for making changes to obtain speeds as high as 1,300 feet per minute. Because a shearing line cannot be operated faster than about 700 feet per minute without excessive buckling of the sheets, provision has been made for coiling the finished strip and then shearing it into sheets as a separate operation when the line is operated faster.

Automatic Tension Control Eliminates Slack

Tension is automatically maintained between the pinch roll and the uncoiler to keep the slack out of the



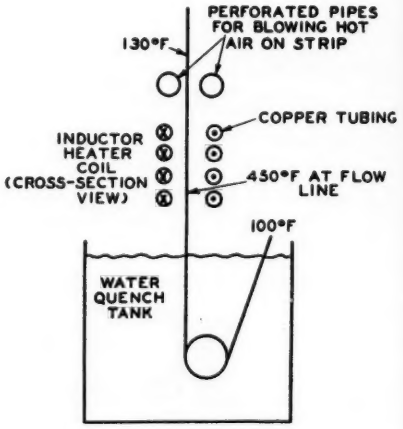


Fig. 5—The electrolytically plated strip, dried by hot air enters the inductor heater coil at 130 deg. F. Here it is heated by high frequency current to the melting point of tin, 450 deg. F., after traversing about 90 per cent of the coil length. At this temperature the rough tin deposit flows into a smooth surface. The strip then runs through the water quenching tank where the tin is hardened and the temperature reduced to about 100 deg. F.

PANELS OF *No-Thru* METAL CONSTRUCTION

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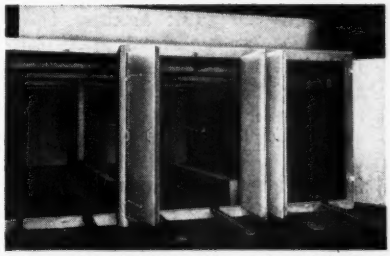
Newcomb-Detroit engineers are always glad to offer recommendations—without obligation on your part—as to the equipment best suited to your requirements.

★ A typical Newcomb-Detroit Panel Type Heat-Seal Oven installation equipped with overhead conveyor system.



★ Newcomb-Detroit Batch Type Ovens, such as that illustrated, are widely used for moisture drying, paint and enamel drying, core baking, armature baking and aging

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strip. With any slack the whipping action would probably break the strip. This same tension regulator also automatically compensates for the change in the diameter of the coil as strip is paid out. The loop is automatically controlled by photo-electric devices that speed up or slow down the entry end of the line as required.

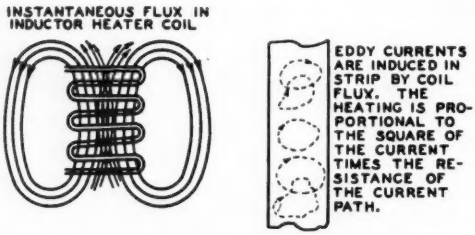
INSTANTANEOUS FLUX IN INDUCTOR HEATER COIL
EDDY CURRENTS ARE INDUCED IN STRIP BY COIL FLUX. THE HEATING IS PROPORTIONAL TO THE SQUARE OF THE CURRENT TIMES THE RESISTANCE OF THE CURRENT PATH.

Fig. 6—The high-frequency current in the inductor heater coil sets up lines of flux. The direction of these lines reverses 400,000 times per second. Eddy currents are induced in the strip as it passes through this rapidly changing magnetic field and cuts the lines of flux. Heat is produced by the resistance of the strip to the flow of these induced eddy currents.

Tension is automatically maintained in the plating unit by having the precision tension unit pull the strip through the tank against the drag produced by the No. 1 drag unit acting as a belt-driven generator. Tension must be accurately maintained to insure a good contact between the strip and the conducting rolls, through which the plating current enters the strip; also there must be no chance for the strip to touch the anodes, thereby short circuiting the plating cell and burning the strip.

From the plating tank the strip passes through the reflow unit into the quench tank shown in Fig. 5, from the quench tank through the branner, and into the precision tension unit. The dull, rough electrolytically tinned steel sheet is passed into the inductor heater coil of a type shown diagrammatically in Fig. 6, where it is heated to the fusion point of the tin. As the dull strip moves through the coils, as shown in Fig. 5, radio waves, 200,000 cycles per second, are passed around the metal, setting up counter currents near the surface and melting the minute peaks down into tiny valleys as shown in Fig. 7, and producing a mirror-like finish as shown in Fig. 8. Shooting into the tin, the waves rip electrons—so tiny you could put ten million, million on an inch-long line — from the atoms of tin. These electrons, driven by the current, smash into one atom after another, creating heat at each collision. The melting action stops when the strip moves out of the coil and is to a quenched to harden and preserve this surface. Next, it is oiled and the excess oil is removed in the branning machine. It is important that the tension be accurately controlled through this sequence also.

Strip Is Sheeted and Sorted

The reeling operation for the line shown in Fig. 3 and the one previously discussed are the same. The strip passes from the No. 2 drag unit to the pull unit, through the pull unit into a loop, and from this loop into the flying shear. Thence it goes to the classifier where it is automatically sorted, and finally delivered to one of two pilers. To obtain accurate lengths of sheet it is essential that there be no tension in the strip as it enters the shear because tension might cause some slippage of the strip on the feed rolls that pull the strip into the shear. For this reason the strip must always enter the shear from a loop. Just before the strip enters the shear it is usually passed through such devices as a pinhole detector and a flying micrometer. These

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The helpful booklet shown above describes these applications in detail. It may assist you in meeting some of today's most urgent production and maintenance problems. A copy of *"The Last Thousandths of an Inch that Speeds Production"* is yours for the asking. In writing please mention *Products Finishing*.

UNITED CHROMIUM
INCORPORATED

function to pick out the sheets with pinholes in them and those that are too thick or too thin. A suitable memory device with either the pinhole detector or the flying micrometer, operates a gate, 10 to 15 feet beyond the shear in the classifier, to shunt, the rejects into the off-gauge piler.

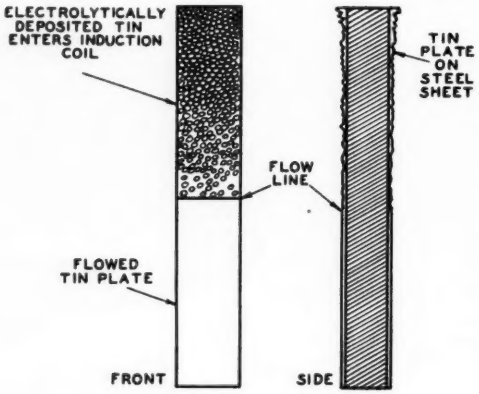

Fig. 7—When the heat caused by the induced eddy currents raises the temperature to the fushion point of the tin, the granular deposit on the steel sheet flows into a smooth, shiny surface.

IR Drop Compensation Assists Flat Speed Characteristics

It is not practical to have more than about 80 feet of strip accumulated in the entry loop. With the strip travelling 15 to 20 feet per second, this is only four or five seconds worth of strip. Because the welding operation requires approximately 30 seconds the line must be slowed down to weld on a new coil. These various drives must, therefore, operate in synchronism not only at the normal running speed, but also at a much lower "threading speed" and the retarding and accelerating periods attendant with this operation.

For this reason all of the driving motors must have a flat speed characteristic over their entire operating range. As the "threading speed" may be at a generator voltage lower than the internal resistance drop of some of these motors it is necessary to use series or "IR" drop boosters so that these drives do not stall at this low speed.

Photoelectric Regulators Adjust for Changes in Line Speed

As this particular line uses Rectox copper oxide rectifiers to supply the plating current, the control will be discussed on that basis. Inasmuch as the coating thickness is proportional to the current and speed, an electronic regulator is used that operates from both a current and speed impulse to adjust automatically the speed of the entire line. This regulator is set for the desired coating weight; then, plating current is applied. This regulator adjusts the main generator voltage to operate the entire line at the speed to give this weight. To change the line speed it is necessary only to increase or decrease the total plating current accordingly.

To reflow the tin in the reflowing zone, a photo-electric regulator is used. This regulator scans the strip as it passes and regulates the heating medium accordingly. Such a regulator is possible, because tin, fortunately, is a solid at one temperature and just a few degrees hotter becomes molten so that the actual reflowing occurs in a narrow temperature zone. This regulator operates essentially as a position indicator and automatically compensates for any change in line speed.

When the shearing unit is operating separately the photo-electric loop control operates in the field circuit of the uncoiler to maintain the loop,

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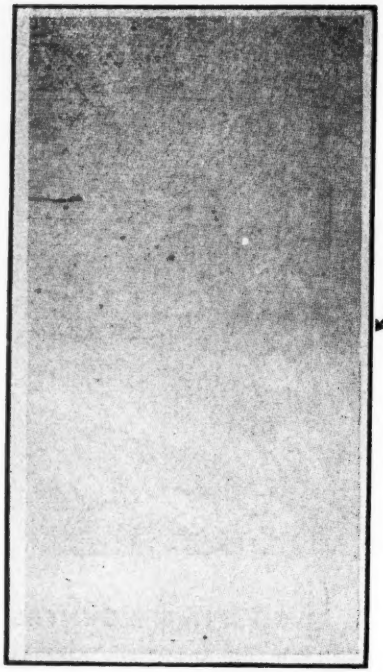


Fig. 8—Full granular deposit of electrolytically plated tin flows into smooth surface when heated to the fushion point by high frequency inductor heater coil. (Photomicrograph at 7 diameter magnification).

which is standard practice. However, when this unit is in tandem with the other two units this method of operation is obviously impossible. Instead, the photo-electric loop control operates in the field circuit of the main generator, used to operate the entire shearing unit. In this way the entire unit is speeded up or slowed down to maintain the proper loop.

3,600 Horsepower Required

The horizontal type of line, a top view illustration of which is shown in Fig. 9, requires the largest power input, which is natural because of its higher production. The line uses about 25 d.c. motors of from one to 125 h.p., and approximately 75 a.c. motors ranging from ½ to 60 horsepower. The plating unit requires approximately 60,000 amperes at 12 volts or 720 k.w., direct current. A total of approximately 600 kilowatts direct current is required from the generators to supply the variable-voltage power. This means, therefore, that the total power for this line at rated load and speed is about 2,700 kilowatts or 3,600 horsepower.

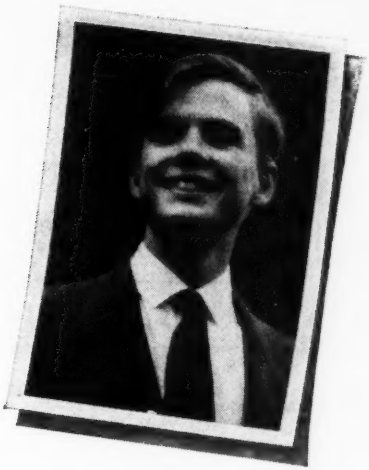
Flowing Improves Corrosion Resistance

Because the tinplate produced on one of these electrolytic lines has a gray matte surface it is desired to reflow the tin coating to obtain the smooth, polished surface to which we are accustomed. This flowing is necessary not only to improve the appearance, but to reduce the porosity of the coating and improve its corrosion resistance.

Several methods have been proposed for this flowing operation. The most importance of these are: passing the tinned strip through a hot oil bath, passing the strip through a radiant tube or some other type of furnace, or using the electrical resistivity of the strip itself to heat it conductively, or to pass it through a high-frequency inductor heater coil, or a combination of these methods.

The hot-oil bath can be used successfully on low-speed lines. Because the differential between the melting point of tin, which is 450 degrees Fahrenheit, and the temperature at which the oil can safely be heated is low, the speed is limited. Further, because this reservoir of heat can be generated only at a relatively low

Son...



HE has just turned eighteen. Shaves twice a week and maybe a hair or two is sprouting on his chest. He shies away now when his dad tries to be affectionate and we noticed some lipstick on one of his handkerchiefs after a country club junior dance not so long ago. But it seems only yesterday, perhaps it was the day before, that he was a chubby legged kid swinging from the arch of the doorway, leading to the dining room, in a gadget that was something like a breeches buoy and he was sucking at the end of a turkey bone.

He went back to school this Fall, a tall, athletic lad, budding into manhood, but there was something else on his mind beside the football and hockey teams or the little blonde girl with whom he had "palled" around during the Summer. It seems as though he was listening for a certain call—the Clarion call that poets sing about—and, perhaps we just imagined it, but we thought we saw an upward jutting of his chin, a certain light in his eyes, and a sort of a rearing-to-go expression in his face.

It chilled us a bit in the region of our heart, when we thought of his discarding the sports coat for the "O.D." of the Army or the blue of the Navy. There was a bit of a catch in our throat as we thought of his putting aside his football helmet for one of steel; of his hanging up his hockey stick and reaching for a gun.

After all we still regard him as just a little boy.

They tell us that the eighteen and nineteen year old lads are to be called to the service. When that day comes to us there will be prayers, but no tears. We shall not mourn nor shall we be fearful. Rather there will come welling up from our hearts that warm feeling of pride that millions of other parents will sense when their beloved lads marched away. Our lad is no different than the others. We are no different than other loving parents, nor is our sacrifice any greater. They are going to make great soldiers, sailors, marines and fliers out of these youngsters. And they will become a mighty force when they take their places beside their brothers in arms. They too know what they fight for. They too know full well of the sacrifices that must be made before the evil powers that threaten the world can be overcome.

And let us not forget that they are counting on us. They know that we shall not fail them.

God be with them and their brothers.

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

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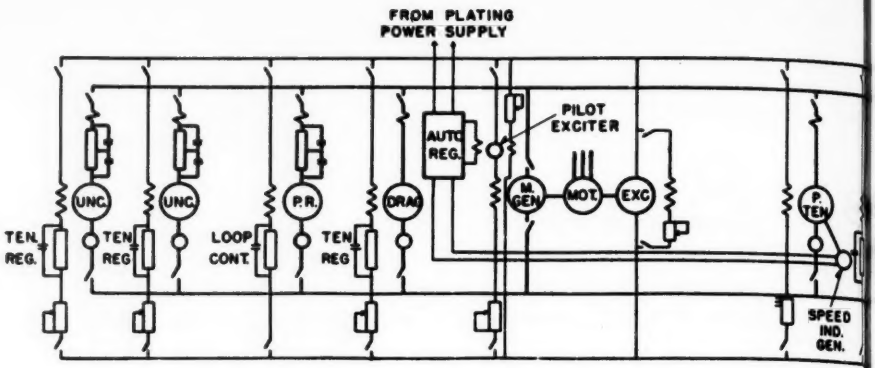


Fig. 9—Circuit diagram of electrical control for variable speed line. This line uses about 25 d.
60,000 amperes at 12 volts. The various drives must operate in synchronism at both normal runnin
characteristic over entire operating range. As the slowest speed may be at
it is necessary to use "IR" dro

rate, and the temperature cannot be quickly altered, the strip must be passed through the bath at constant speed.

The furnace method also is satisfactory for low-speed work, but becomes quite bulky as the speed of the strip is increased. The furnace must be from about one-third to one-half foot long for each foot per minute that the strip travels; a practical limits of 200 to 300 feet per minute is set for the radiant furnace method. Here again, the heat can neither be generated nor dissipated at a high rate, which restricts its use to a constant-speed operation. Both the hot oil and the furnace methods do not lend themselves readily to incorporation in the electrolytic-tinning line itself, but make flowing a separate operation. This, of course, entails additional handling of the strip during processing.

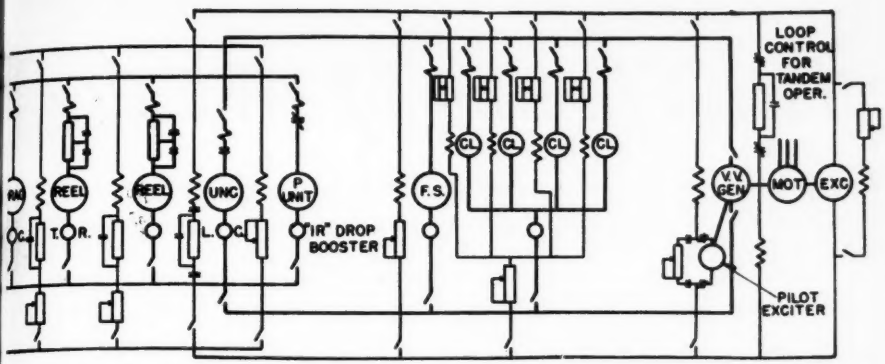
High-Speed Conduction Heating May Cause Marred Surface

Melting the tin by the heating effect of current flowing through the tinplate itself does not have speed limitations. It does not restrict the process to a constant speed inasmuch as the current can be readily controlled as the speed is changed.

With this method, however, there is the problem of getting the power into the strip at high speeds without arcing and burning at the contact rolls where the power is introduced into the strip. Because the strip with the coating heated is in actual contact with the current-collecting rolls, there is a possibility of marring the tin surface. By this method it is necessary to heat a section of the strip while at the same time attempting to quench it.

Induction Heating Permits High Speed Continuous Operation

By the induction method, the tinned surface is brought to the melting point of tin by the same methods now extensively employed by industry in electromagnetic heating except that the frequency and power involved are much greater. In fact, the equipment is a broadcasting set of enormous power. Based on a strip speed of 1,000 feet per minute an oscillator of 1,200 kilowatts output is required for most commercial strip.



motors of from one to 125 h.p., and 75 a.c. motors from ½ to 60 h.p. The plating unit takes about speed and at a much lower threading speed. All driving motors must, therefore, have a flat speed generator voltage lower than the internal resistance drop of some of the motors, boosters to prevent stalling.

It is interesting to note that just one of these induction heating units has a radio frequency output of 24 radio broadcasting stations of 50 k.w. capacity. This equipment requires approximately 2,300 kilowatts of power input and covers a floor space of approximately 650 square feet.

In the induction system there is no physical contact between the strip and any stationary or rotating member. Thus, there can be no marking of the strip either by electrical or mechanical action. The heating is done in a very short space even at high speed, the space required being in the order of 10 to 12 feet at a speed of 1,000 feet per minute. No heating is done at the time that the strip is being quenched.

Inasmuch as flowing of tin is a relatively new operation, practical experience may indicate the wisdom of using some combination of these flowing methods. Such a combination might be to use both electric conduction and induction, in which the tin is preheated by current carried through the strip and the final heating to the reflowing temperature accomplished by induced current.

The complete process can now be performed in one line instead of several operations, each requiring additional handling of the steel. The coating applied has been reduced to approximately one-third, by weight, of its former value. This development is, therefore, one of the major advances being made in the steel industry today.

Republic Lead Coatings. A 12-page bulletin containing information and data on service maintained by United States Stoneware Company, 60 E. 42nd St., New York City, to lead-line equipment that is subject to corrosion in operation is now being issued by the company. Representative units which can be corrosion-proofed include agitator blades and shafts, blower housings, shipping containers, heat-exchanger coils, blower impellers, fan blades and autoclaves.

The process of coating employed by the company includes cleaning by suitable means, application of a skin coat of the lead followed by the first lead layer to approximately ⅛-in. thickness. The first layer is scraped to remove impurities to a remaining thickness of approximately $\frac{1}{16}$ inch. Subsequent layers are applied in a similar manner to the desired final thickness of ½ in. or more. Usually ¼ in. is sufficient.

Copy of Bulletin 1700 may be obtained free upon request.

Hot-Tinning of Metals

The following general report on British hot-tinning practice should be of interest to every metal finishing executive.

By E. R. YARHAM
Manor Farm House, Oulton, Norwich, Norfolk, England

BECAUSE the Japanese have temporarily succeeded in occupying British Malaya, the world's most important source of tin, and the Netherlands East Indies, which also has valuable resources, sources comparatively neglected in the past—such as the ancient tin mines of Cornwall—are being worked again in order to meet war-time requirements.

Tin has been worked as long as any metal, and the art of coating metals with tin by dipping them into the molten metal is of known antiquity. Because of its importance in modern industry a considerable amount of research and experimental work has been carried on. The Tin Research Institute has accumulated much valuable information over a period of years, and C. E. Homer, B.Sc., Ph.D., has written an outstanding treatise on the subject.

Electro-tinning, he states, is now a satisfactory process for industrial use, and it gives effective protection to a variety of basis metals. It is applied to mild steel, carbon steels, copper, and many copper alloys. The average thickness of coatings applied to fabricated articles by hot-tinning is 0.0005 to 0.001 inch, and bright lustrous coatings may be obtained without polishing, and another advantage is they do not tarnish readily in the atmosphere. Furthermore, the plant required is simple: where the finest finish is not necessary, all that are needed are a tinning pot and an unheated pickling tank. The tinning operation is very rapid, because the time of tinning is only a few seconds. Tin-lead alloy coatings can be applied as easily as pure tin, and this reduces the cost for certain types of work. The hot-tinning process is operated by tinners who rely on their experience and personal skill rather than on scientific control. This is understandable, since tinning is an old trade, where skillful manipulation is still required even where facilities for scientific control are available.

When an article is to be treated it is cleaned, usually by degreasing, followed by acid pickling — and then dipped into the molten tin bath. After the required period of dipping the article is taken out, the surplus tin is drained off, and it is allowed to cool. If properly carried out, a continuous layer of alloy covers the basis metal, which is covered with a smooth, bright, uniform layer of pure tin. The tinning bath consists of a steel or cast iron pot mounted so that it may be heated conveniently by coal, gas, oil or electricity. In the old type of installation the pots are set up in a row on brickwork and heated by coal fires. Modern tinning baths are generally made in separate units, and the majority are gas-heated, although electric heating is

Facts about
Metal Polishing

Importance of Correct Drying of a Glue-bonded Polishing Wheel

ANIMAL hide glue has the property of taking on or giving off moisture, depending on prevailing weather or on the relative humidity in the dry room. Since hide glue reaches its maximum strength when it contains 10% to 12% moisture, the wheels should, therefore, be dried until the glue has this moisture content. This means that the dry room should be regulated not only for temperature but also as far as possible for relative humidity. Ideal drying conditions are 85° F. and 50% relative humidity. If these conditions are maintained with reasonable accuracy, most one-coat polishing wheels can be dried within 24 hours and two-coat wheels within 48 hours.

Drying time is dependent on the thickness of the wheel head; the thicker the head the longer the drying time. The strength of the glue, the abrasive grain size, and the number of coats determine the thickness of the head. For instance, a wheel set up with coarse grain requires a heavier glue solution than one set up with fine grain. For the same number of coats the head is thicker with the coarser grain, requiring a longer drying time.

A practical test to find out when a wheel head is dry enough is to hit it with a round steel bar and observe the readiness with which it cracks.

NORTON COMPANY, Worcester, Mass.

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NORTON ABRASIVES

gaining in use for the smaller sizes. Thermostatic control is often provided for accurate and dependable measure of temperature.

Most of the steel dipped is mild steel, although sometimes for special purposes medium-carbon and alloy steels are tinned as well. Mild steels and most plain carbon steels are suitable materials for tinning, but the majority of alloy steels are difficult to tin satisfactorily. Mild steel is handled in the form of sheet, strip, and wire, or articles fabricated from them, while carbon steels are tinned in the forms of wire and various machine parts such as bearings.

Degreasing is an important process. Most steel sheets and strips are coated with some oil or grease, applied to prevent rusting in storage, and when articles are fabricated from them more lubricant is applied. Thus, degreasing is essential before pickling and tinning can be carried out. There are three main methods employed: organic solvents, alkaline solutions, and heat. The organic solvent generally used is trichlorethylene, and cleaning is effected by placing the articles either in the hot solution or the vapor. The cleaning of greasy steels in alkaline solutions is somewhat difficult, since many of the oils and greases met with are not saponified, and are only slowly removed by the usual alkalies such as caustic soda and sodium carbonate. The method of heating or "burning-off" is often used, and may often be combined with the annealing required after deep-drawing or pressing. It is effective to a marked degree if the correct temperature is reached. This depends on the steel and the nature of the oil or grease applied to it dur-

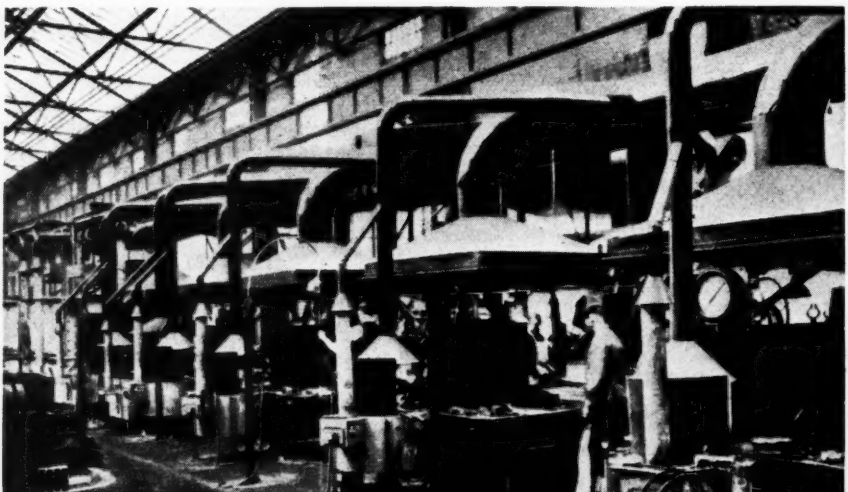

Fig. 1—View of gas fired tinning baths employed in tinning bearings shells

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Rack, courtesy East Liberty Electroplating Company, Pittsburgh.

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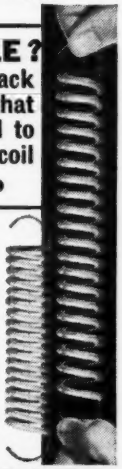

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NELSON J. QUINN CO., TOLEDO, OHIO, U. S. A.

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ing fabrication. A temperature of 600 deg. C. or 1,110 deg. F. upwards is usually necessary.

Pickling is carried out to remove scale, rust, and dirt from the surface of the steel, thus providing a clean surface for tinning. An acid pickling solution dissolves rust and also the layer of scale next to the surface of the steel. To pickle steel effectively and to avoid excessive attack, rust and scale must be removed relatively quick. The two acids most used for this purpose are hydrochloric and sulphuric. The former is generally used by tinners of fabricated articles, while the latter is preferred in tinplate manufacture. Hydrochloric acid has the advantage that it works quite efficiently when cold, and generally no provision is made for heating it. Used thus it is relatively slow in action, and its attack on the steel is slight. Sulphuric acid does not work efficiently as a pickling bath unless heated to a temperature of about 70 deg. C. (160 deg. F.), but at this temperature its action is more rapid than that of cold hydrochloric acid. For pickling difficult steels a solution of nitric acid is sometimes employed, and this has the advantage that it works very rapidly.

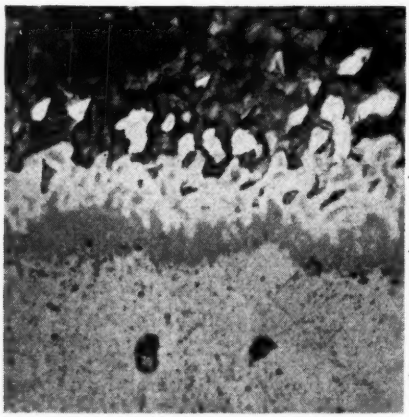

Fig. 2—Section of tin coating on copper, showing alloy layer. x 1000

Fluxes are used in hot-tinning in two different ways. A solution of a flux in water is used for dipping articles before they are immersed in the molten tin, and a layer of molten flux is generally used as a cover for the tin bath, in order to keep its surface free from oxidation. The flux generally used as a preliminary dip is an aqueous solution of zinc chloride. As the article, wet with flux, is immersed in the tin bath, the surplus water boils off and the zinc chloride melts. The molten salt reacts with the surface of the metal being tinned, and removes films of oxide so that it is perfectly clean at the moment when it comes into contact with the tin. The flux used as a covering layer on the top of the tinning bath is of the same type as that used as a preliminary dip.

The actual tinning may be carried out with either one or two pots of tin, according to the quality of finish required. For the best results, two pots are used, the first being covered with a layer of molten flux and the second with tallow or palm oil. When only one pot is used, it is always covered with flux. The advantages of using two pots are that the tin in the second may be kept free from iron contamination, and that any flux adhering to the articles on withdrawal from the first bath is removed by the second dipping. Like this a smoother and cleaner finish is obtained. The tallow or palm oil on the second pot keeps the surface of the tin clean and free from dross, any any grease sticking to the articles can be easily cleaned off. More-

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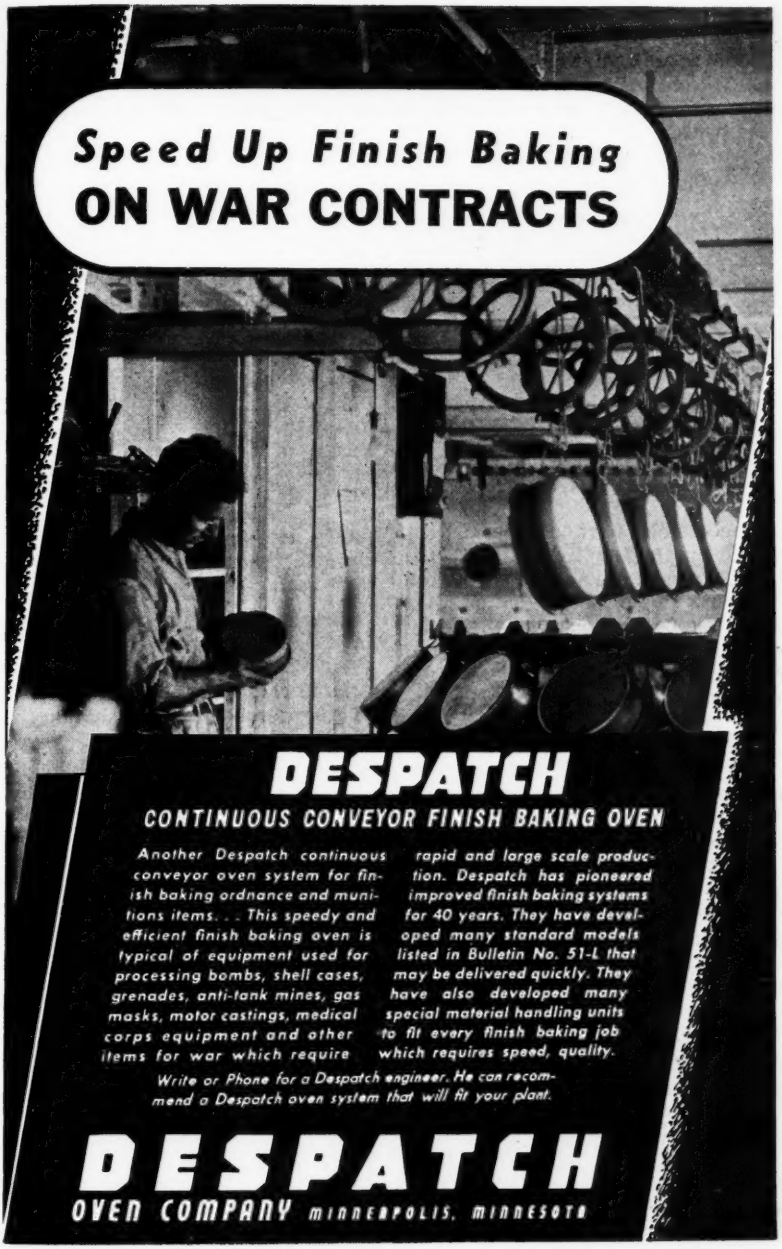
over the presence of slight greasiness on the surface of the tinned articles assists in preserving their bright finish during storage and in preventing rusting.

The articles are taken one at a time from the cold water storage vat, dipped in flux and immersed in the first tin bath, which is covered with about ¼ inch of molten flux. Care is taken not to immerse them too rapidly, since the sudden evaporation of the water would cause splashes of flux and tin to be blown out of the bath. On the other hand, the rate of immersion must not be very slow, as it is desirable that the surface of the article should still be wet as it comes into contact with the molten flux. The time of immersion has to be sufficient to allow the article to reach the temperature of the molten tin. This depends on its thickness, and varies from a second or two for thin sheet metal articles to a minute or more in the case of large articles such as milk cans.

When the article has been immersed for a suitable time it is withdrawn, and, if a second dip is not to be carried out, particular care is taken to avoid adherence of flux or dross. It is found that this is facilitated by pulling the article through the surface of the bath with a jerk. The surplus is then drained off. It is found that considerable practice in handling the articles is necessary in order to obtain the cleanest results. Hooks are better than tongs, although the latter are essential for certain types of work. The tongs have to be tinned and heated to tinning temperature before use. With larger articles such as milk cans a supporting cradle can be employed. The usual working temperatures are about 280 deg. C. (535 deg. F.) for the first pot and 260 deg. C. (500 deg. F.) for the second. In certain cases, where solidification occurs before the last thick streaks of tin have reached the lowest point, final draining is assisted by carefully heating it with a gas flame.

The rapidity with which the molten tin coating solidifies has an influential bearing on the brightness of the finish. If the coating remains molten for a considerable time, draining proceeds too far, and on the upper parts of the article there is insufficient tin left to give a bright finish, or the tin is liable to be oxidized a yellow color. On the other hand, if the cooling is too sudden, the rapid solidification causes the coating to have a "frosty" appearance, and this is unattractive for many things, although the protective value is unimpaired. The rate of cooling should therefore be controlled. Articles made from thin sheet steel, such as baking pans, and domestic utensils, give the brightest finish when allowed to cool naturally in the air. Larger articles of heavy gauge steel, such as dairy utensils, normally cool rather too slowly in the air; a brighter result is obtained when they are quenched in oil. Paraffin is most commonly used for this purpose, since it is fluid and is easily drained and cleaned off the articles afterwards.

The purity of tin has a marked influence upon the brightness of the coating, and in general it may be stated that the higher the purity the brighter the coating. The commonest impurity in tin is lead, and when the tin contains an amount such as 0.2 to 0.5 per cent, this in conjunction with the small amounts of other impurities present, causes the coating to be noticeably spangled. For many types of work this is not objectionable, but for high-grade domestic articles on which the brightest finish is demanded, tin of a purity of about 99.9 per cent is best. Many tinned articles do not need any finishing beyond rubbing with sawdust while still hot, in order to remove tallow or quenching oil from the surface. Some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OVEN COMPANY MINNEAPOLIS, MINNESOTA

articles, however, have adhering flux spots or are stained yellow by oxidation due to a high tinning temperature. The easiest method of dealing with these is to quench the articles in hot water, and in especially bad cases to rub them with a rag or brush. When the spots of flux are in an inaccessible part of the article, the best method is to add 0.5-1 per cent of hydrochloric acid to the water, and follow this by washing in plain water. Yellow stains due to oxidation can be removed by immersion of the articles while hot 0.5. solution of hydrochloric acid. The stain is removed in a few seconds, and with this strength of acid the tin is not etched.

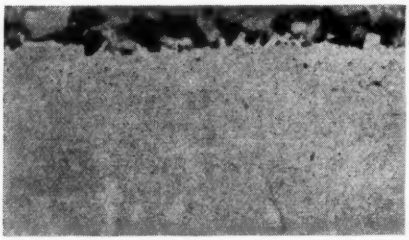


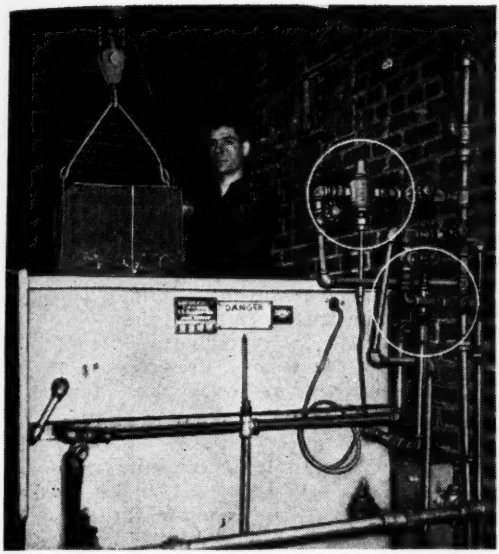
Fig. 3—Section of tin coating on steel, showing alloy layer. x 500

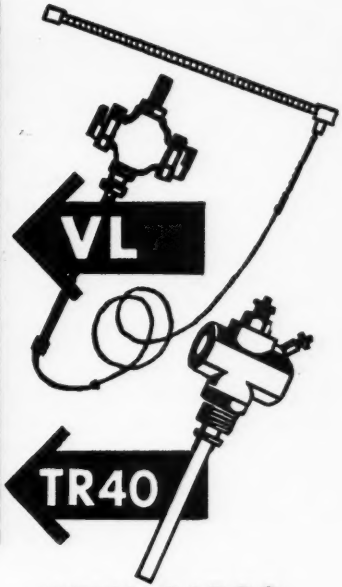
Sal-ammoniac tinning is particularly applicable to articles made from thin steel, one tin bath is used and it is not provided with a cover of flux. The article is prepared for tinning in the usual way and dipped in a zinc chloride flux solution. A little powdered ammonium chloride (sal-ammoniac) is then sprinkled on the surface of the bath, and the article is dipped while the ammonium chloride fumes are still being given off. The volatization of the chloride keeps the surface of the tin free from oxidation, and the article may be withdrawn with a clean finish.

The re-tinning of such articles as milk cans does not differ much from the tinning of new articles, but in general the procedure is simpler. The surface of any steel exposed by removal of the tin coating must be perfectly clean and free from rust. If the articles have been used for containing milk or other food products they are likely to be greasy and must be degreased in an alkaline solution. A hot 10 per cent solution of caustic soda or caustic potash is used, since the grease readily saponifies, but this mixture is preferable, as it easily rinses off afterwards: soda ash (anhydrous sodium carbonate) 8 oz., trisodium phosphate 2 oz., caustic soda 2 oz., and water 1 gallon. After degreasing the articles are washed and it is generally necessary to pickle for a short time in the normal cold hydrochloric acid bath.

Grease-tinning is an old process, in which, in its original form, molten grease takes the places of fluxes such as zinc chloride. In this way the risk of the presence of corrosive flux spots on the finished articles is avoided, and the articles may be stored for a considerable time without rusting or discoloration. Articles for grease-tinning are degreased, pickled, and washed as described before. The tinning plant consists of five pots: grease-pot, rough-tinning pot, finishing pot, grease-pot for draining off surplus tin, and listing tin pot for removing drips. The tinning stack (where the pots are situated) is worked by three operators, who deal with: rough tinning, brushing and finish tinning, and draining and listing. Cleaning and polishing requires two more operators.

The first grease pot is used merely as an unheated storage pot for the grease, which is ladled from it on to the top of the rough-tinning pot to a





More Production

WITH SARCO TEMPERATURE CONTROLS

Maximum production demands intelligent use of steam so that none shall be wasted. Sarco steam traps and temperature regulators can aid mightily in this effort.

For example, take modern cleaning of metal parts as in the degreaser above. Simple self-operated Sarco valves regulate both heating and cooling coils to keep the vapor at the correct level.

Waste of steam, waste of expensive solution, waste of cooling water are prevented and a uniformly clean product is assured.

Sarco steam traps assure fast heating and Sarco temperature regulators prevent waste. Ask for the catalogs.

158

SARCO SAVES STEAM

SARCO COMPANY, INC.
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depth of a few inches. The articles are taken from the water vat, dipped into a solution of the usual zinc chloride flux, and immersed in the tin pot through the layer of grease. Sufficient articles are immersed to fill the pot, a rack being provided to stand them on, and the grease is then ladled back into the grease pot. The articles are removed one at a time, in the same order as they were put in, and passed through the remainder of the process. When the article is removed from the rough-tinning pot, it is lightly brushed over with a soft hemp brush dipped in melted grease to remove any dross, etc., and placed in the second tin pot. This is covered with a thin layer of grease, and maintained at 250 deg.-260 deg. C. (480 deg.-500 deg. F.). The article is dipped only momentarily before being transferred to the grease draining pot for removal of the surplus tin. A suitable time of immersion in the draining pot is 5-10 seconds, and the temperature is maintain at 245 deg.-250 deg. C. (470 deg.-480 deg. F.).

On removal from the draining pot, the article has a drip of tin at the lowest point, and this is removed by bringing it carefully into contact with the surface of the tin in the listing pot. This is a shallow pot, containing molten tin at about 250 deg. C. (480 deg. F.). Solidification of the coating occurs quite rapidly, on account of the relatively low temperature of the final draining pot, and with sheet metal articles of average thickness the brightest finish is obtained by ordinary air cooling. The condition of the grease is an important factor in the working of the process. Originally, best Russian tallow was preferred, but ordinary beef or mutton tallow is commonly used today. Palm oil is also suitable, and is often mixed with tallow, though it is not generally used alone. A recent development is the use of special mineral oils, which promise to be valuable on account of their stability when heated.

Many articles manufactured from tin-plate are subsequently tinned by the grease process, and it is often necessary to re-tin tinned articles on which the coating has become worn. Such articles are tinned in the finishing tin pot only and then finished off in the draining pot as usual. When articles requiring retinning have become rusty in use, they are first pickled in hydrochloric acid, and in bad cases they are treated in the same way as new articles made from black steel.

For some purposes, where appearance is not of great importance and the articles are not to be used in contact with food, a tin-lead alloy coating is employed. It is rather grey in color, depending upon the percentage of lead in the bath, and not so bright as pure tin. On the other hand, it is somewhat easier to apply than pure tine. Any composition between pure tin and about 95 per cent lead will give a coating on steel quite readily, but usually the amount of lead added to the bath does not exceed 50-60 per cent. The preparation of steel for tinning in a tin-lead bath is carried out as for pure tin. Tinning is done in one pot only, not using a zinc chloride flux solution. The tinning bath is not covered with a thick layer of flux, a little only being floated on it and this kept to one side. The flux carried into the bath by the articles keeps the surface free from oxidation, provided that the temperature is not too high, and this flux is skimmed aside from time to time.

It is not often necessary to tin steels containing high percentages of alloying elements, but the tinning of steels containing small additions of nickel, chromium, etc., has to be carried out occasionally. Generally

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This is the age of the specialist. The era of the man, who has so narrowed his field of concentration that he knows practically everything about almost nothing.

Now, as compared with the total of your manufacturing problems, finishing is practically nothing at all. Yet, about finishing, our specialized engineers know a great deal.

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speaking, good tinning can be obtained by the methods described. The tinning of grey cast iron is complicated by the presence of flakes of graphite in the metal. With some grey irons it is necessary to apply a preliminary electro-deposited coating to which the tin will adhere satisfactorily. Pickling is best carried out by mechanical means and for a few minutes only. Either sand- or shot-blasting or tumbling may be employed.

The last is generally preferred for small articles such as mincer parts, while large castings must be sand-blasted. The only requirement is that the sand and scale should be removed, and the surface left smooth and free from grease. When sand-blasting is employed care has to be taken to avoid the presence of oil in the supply of compressed air. Pickling depends to some extent on the previous treatment. When the articles have been tumbled there is generally nothing to be removed other than a thin film of graphite which has been spread over the surface by the burnishing action of the tumbling operation. This is removed by pickling for about five minutes in cold hydrochloric acid solution, or for about two minutes in hot sulphuric acid. After sand-blasting, or when traces of moulding sand remain in the surface after tumbling, it is advantageous to use a cold 5 per cent solution of hydrofluoric acid. The tinning can be carried on as usual if the iron will take the treatment satisfactorily, if not an undercoat of electro-deposited iron should be applied.

The tinnning of very small articles as screws, nails, and so on cannot be satisfactorily or economically carried out by dipping them individually in the tin bath. A barrel-tinning machine can be employed, or, when only a small number of parts have to be dealt with, quite good results may be obtained by tinning them in a closed wire basket, in which they are afterwards shaken by hand to remove surplus tin. If the shaking is continued until the coating has been solidified, the finish is somewhat dull and rough, but a bright finish may be obtained by emptying the contents of the basket on to a slab or tray just before solidification.

The tinning of copper and copper alloys follows in general the procedure outlined for steel with differences, however, in detail.

Fostoria 32-Page Brochure. Containing over 100 illustrations of infra-red as a tool for peace and war and complete descriptions on each, this brochure, now being issued by The Fostoria Pressed Steel Corporation, Fostoria, Ohio, is a most complete and elaborate presentation on the subject. It will suggest uses for the process where paint baking, drying, dehydrating and preheating are involved.

The opening pages describe "what the process is" and "how it operates"; next follows the many installation pictures and case histories. The inside back cover shows user satisfaction through testimonial letters of several well-known American manufacturers.

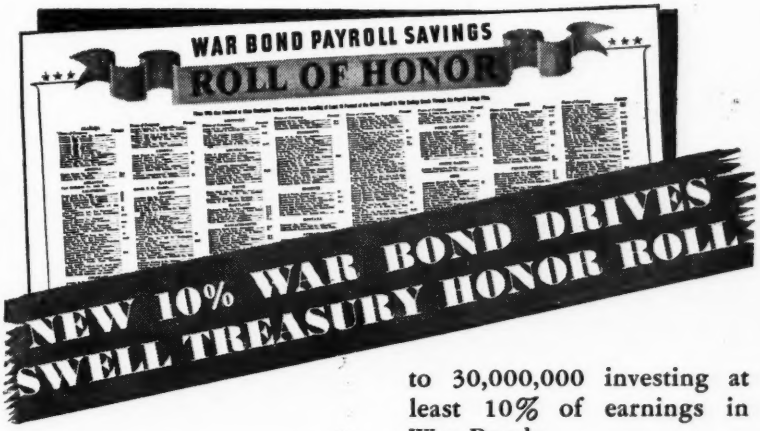
Copy may be obtained by writing request upon company letterhead.

American Cyclone Dust Collector Catalog No. 82. Complete information on the American High Efficiency Cyclone Dust Collector is contained in an 8½ x 11-inch spiral bound catalog published by the American Foundry Equipment Co., 555 S. Byrkit St., Mishawaka, Ind. Profusely illustrated, the catalog clearly shows all of the mechanical features and specifications of the collector and thoroughly explains the construction and operating details.

Also included in the catalog is a secton containing essential data for efficient operation of a dust control system, technical layouts, and engineering tables and charts, especially useful in planning applications of dust control units.

Copy of Catalog No. 82 free upon request.

$100.00 War Bonds Now $75.00



AS of today, in more than 20,000 firms of all sizes have reached the "Honor Roll" goal of at least 10% of the gross payroll in War Bonds. This is a glorious testimony to the voluntary American way of facing emergencies.

But there is still more to be done. By January 1st, 1943, the Treasury hopes to raise the present total of 20,000,000 employees investing an average of 8% of earnings to 30,000,000 investing at least 10% of earnings in War Bonds.

You are urged to set your own sights accordingly and to do all in your power to start the new year on the Roll of Honor appearing in the "Payroll Savings News." For copy write War Savings Staff, Treasury Department, Washington, D. C.

TIME IS SHORT. Our country is counting on you to

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This space is a contribution to America's All-Out War Effort by PRODUCTS FINISHING

Finishing Facts

Palladium for Jewelry

COMMENTING on the recent order of the War Production Board restricting the use of platinum in jewelry, Charles Engelhard, of Baker and Company, Inc., 113 Astor St., Newark, N. J., leading authority on platinum metals in the U. S. A., concurred in the recommendation of the Board concerning the use of gold and palladium instead of platinum. He stated that the jewelry trade is indeed fortunate in that it has available without restriction as to its use, ample supplies of gold and palladium.

Mr. Engelhard, whose company is regarded as the world's largest dealer in platinum metals, asserted that "while the restriction of platinum may cause some temporary inconvenience, if not hardship, to jewelry manufacturers, retailers, and to the public, platinum is very important to the war program and is used for industrial purposes in the manufacture of war materials."

He also stated that "the order of the Board has created many inquiries from the jewelry trade as to the availability of palladium, its working properties, and its usefulness in the manufacture of jewelry." Mr. Engelhard added that "Baker and Company is placing its staff of metallurgists and other technicians at the disposal of the jewelry manufacturers to assist in dealing with the problems which may have arisen through issuance of the order prohibiting the use of platinum."

Mr. Engelhard advises that "palladium is available in sufficient quantities to furnish the jewelry trade with a satisfactory alternate for platinum, and that the major sources of supply lie in Canada, Alaska, and South America. Even though palladium is more rare than gold or platinum, as considered from the point of view of recovery from ores or other natural deposits, it is today possible to effect its recovery in worthwhile commercial quantities by modern metallurgical processes developed over the last decade."

He added that "palladium has been used for jewelry manufacture, sometimes in alloy form with other members of the platinum family. These alloys have the required strength and hardness for rings and for the setting of gems with security, and they can be readily worked into delicate, lacy designs for pins, brooches and other larger pieces.

"Palladium is lighter in weight than platinum, is about as heavy as 14 K yellow gold and has a current market value approximating 70 per cent of that of platinum."

The platinum authority concluded that "the jewelry manufacturer who has had some familiarity with palladium and its alloys has found them readily workable in all operations, with hardness and strength equal to that of iridio-platinum, and he knows the finished jewelry will have a lasting brilliance without tarnish."

Mr. Engelhard is confident that the jewelry buying public will recognize palladium as a metal similar to platinum in appearance. Its color is ad-

mirably suited for the setting of diamonds and it harmonizes with the colors of other gems.

More Vital Materials for Our War Effort

CHEMICAL "balloons" are now lifting from low-grade minerals which were once disregarded, quantities of vital copper, zinc, lead, nickel, tungsten, chromium and other strategic metals for military production, E. I. du Pont de Nemours & Company, Wilmington, Del., recently announced.

Working of low-grade deposits formerly thought of little value is made possible by so-called froth flotation. Chemicals with an affinity for the grains of ore lift them in a bath from the worthless "gangue" or residues with which ores are associated in the earth.

Copper and zinc for shells, lead for bullets, copper for wire in motors, communication and power lines; vanadium, nickel, tungsten and molybdenum for special steels; manganese, chromium and a host of other vital metals are now obtained by froth flotation. Flotation agents have been used for many years, but new chemicals developed by Du Pont and others in recent years have improved the practical and economical recovery of ores from low-grade mineral deposits.

In mining camps of the United Nations enormous loads of low-grade ore ground in water flow daily into boxes, called cells. Minute amounts of chemicals are mixed with the ore.

The chemicals attach themselves selectively to the grains of the valuable minerals, and air bubbles lift them to the surface. Then the precious minerals are scraped or skimmed off the surface. Subsequent smelting and refining give important metals that go into tanks, planes, ships, guns, and other implements of war.

3 WAYS TO PREVENT RUST

DURING AND AFTER METAL CLEANING

ACTUSOL in machine rinse tanks

ACTUSOL dip after soaker tank work

ACTUSOL without rinse

The Du Bois Company

CINCINNATI, O

One gal. Actusol to 100 gal. water in washing machine rinse tanks puts a microscopically thin film on the surface that prevents rusting between operations. This will not interfere with subsequent operations.

To prevent rusting, the soaker tank operation may be followed by a dip in a solution of 1 gal. Actusol to 100 gal. water. This will retard any tendency toward rusting, provided the work is not stored in excessively humid conditions for long periods.

If work is to be shipped or stored for long periods of time dip momentarily in a mixture of 1 part Actusol and 1 part kerosene. If further finishing is required after storage or shipment the Actusol may be removed with water alone . . . no solvents needed.

Warehouse stocks and Service Men in cities from coast to coast . . . for prompt delivery and consultation.

Ingenious Cleaning Machine Speeds Output of Metal Specialty

A General Electric Calrod heater installed in a washing machine at the Koch Manufacturing Company, Louisville, Ky., is speeding the output of a small metal specialty made by this company.

After the specialty has gone through the manufacturing process it is cleaned in a liquid soap solution heated to 190 deg. F. Formerly the solution was heated in a tank by gas, but much valuable production time was being wasted because of the excessive time required to bring the solution up to the proper temperature.

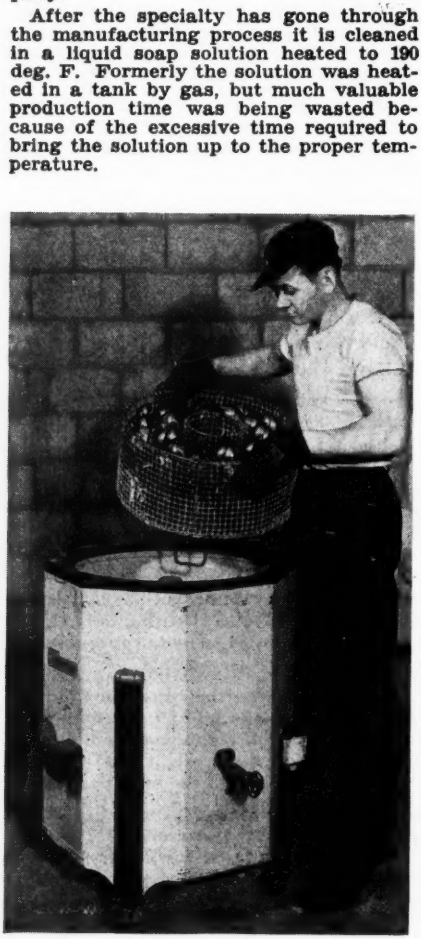
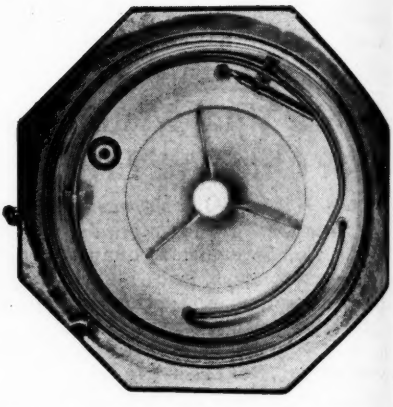


Illustration showing view of a Koch Jiffy Cleaner



Interior view of Koch Jiffy cleaning unit showing installation of Calrod heating element

To speed the heating of the soap solution, Louis A. Koch, owner of the Koch Company, devised what he calls a "jiffy" cleaner. Consisting simply of a G-E 5,000-watt, 230-watt Calrod heater looped around the bottom of the washing machine, the "jiffy" cleaner brings the solution to the proper temperature eight to ten times faster than by the old method, and has resulted in cooler working conditions, more accurate control of heat, and more ecnomical operation.

The parts to be cleaned are placed in the machine in a special wire rack so that they will not strike the agitator or come in contact with the heater.

Oakite De-Scaling Manual. Due to war demands for increasing output of existing equipment, shortening shutdown time and conserving man-power in handling the required maintenance work in the metal-working industry today, the newly revised and enlarged fourth edition of a 24-page de-scaling and cleaning manual issued by Oakite Products, Inc., 20 Thames St., New York, is of particularly timely interest to works managers, plant superintendents, master mechanics, foremen or other maintenance men having these responsibilities.

The manual concisely reviews safe, economical methods for effectively, speedily removing lime-scale, rust and similar deposits from many different types of water-cooled or water-circulating equipment to restore normal heat

transfer efficiency or effect other improvements essential from the standpoints of equipment operation and performance. Among the units discussed in this connection are blast furnace cooling coils, metal washing machines, lead oxide mixers, spot welding machines, cutting and quenching oil cooling coils, Diesel engine water jackets and radiators, lube oil and jacket-water coolers, refrigerant condensers and compressors, surface condeners, feedwater heaters other heat exchangers.

In this connection, considerable data is given on how a specially designed scale-dissolving material, Oakite Compound No. 32, not only eliminates the hazards to personnel and equipment so frequently involved with the use of commercial raw acids, but also avoids the need for tedious, time-consuming mechanical methods on a wide range of scale and rust removal work.

Another interesting feature of the booklet, particularly from the production angle, is the information presented on removing mill scale and other scale deposits from heat treated, hardened, annealed or welded parts or surfaces before subsequent finishing operations, and also removing rust from parts between manufacturing or assembly operations, and from exterior surfaces of machinery or equipment for maintenance purposes. Copies of this fact-filled, illustrated manual are available upon request. Write to Oakite Products, Inc., 20 Thames Street, New York City.

Industrial Research. The Chemical Publishing Co., Inc., 234 King St., Brooklyn, N. Y., has announced the publishing of "Industrial Research" by F. Russell Bichowsky. This book is a manual for the research director and for the business executive, real or potential. It presents in a concrete form what may be thought of as a philosophy or theory of research in its social aspects.

Industrial Research is said to be based upon considerable personal experience in laboratory management, but chiefly on the accumulated experience of laboratory executives all over the country. The purpose of the book is to display the social importance of research and to outline those general principles of management and organization which have proved successful in the laboratory.

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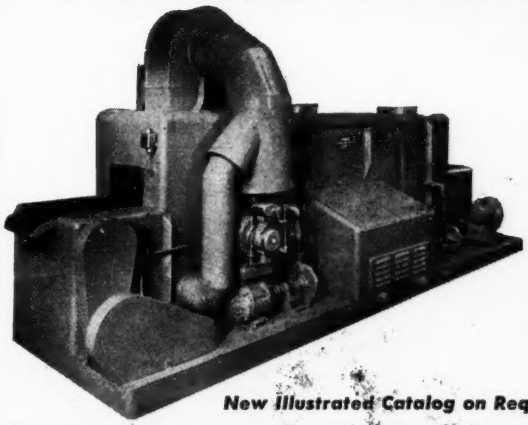

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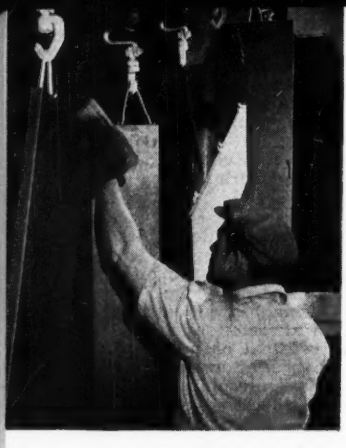
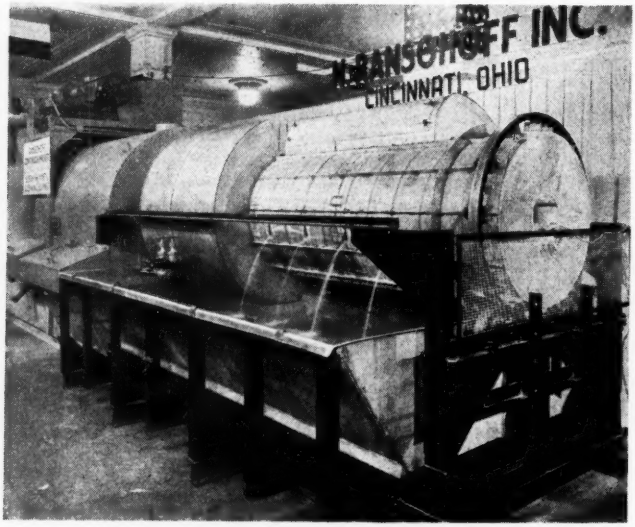


News OF THE INDUSTRY

Ransohoff Exhibit

Among the popular exhibits at the National Metal Exposition held in Cleveland in October was that of N. Ransohoff, Inc., Township and Big Four R. R., Cincinnati, Ohio, maker of equipment for the surface treatment of metals. Unusual interest was displayed in the continuous parkerizer here illustrated which was in operation and demonstrated by experts from the plant. The machine is a complete parkerizing unit. It eliminates manual labor in putting work through parkerizing, rinsing, chromic acid rinsing, blow off, oil dipping, and drying.

The drum, patented by N. Ransohoff, Inc., is so built that it holds a level of liquid within approximately three inches of the center, which insures complete submersion of the work. It also permits continuous circulation of the parkerizing solution without agitation between the drum and the heating tank to maintain constant temperature of the liquid in the drum. The machine can be arranged for steam or gas heating.



Ransohoff Exhibit at National Metal Exposition

Employee Publication Introduced

The Detroit Rex Products Company, manufacturers of Detrex degreasers, alkali washers, and chemical cleaning compounds, announces the publication of a new company newspaper, the "Detrex News." This monthly news magazine is mailed to employee's homes, to former employees now in the armed

forces, and to all field men and branch offices. Employee activities in all departments are covered with interesting news slants and photographs. Important informative bulletins, such as gas rationing and tire conservation, are included. Designed to maintain the present high employee morale, "Detrex News" will gather the bulk of editorial material by means of employee reporters, established in the various plant departments and offices.

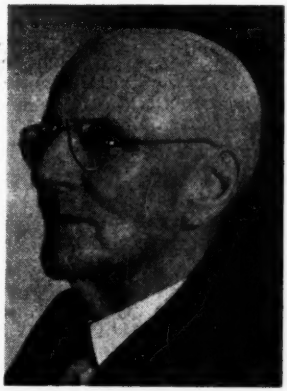
Courtney & Co. to Represent E. Reed Bruns

E. Reed Burns Manufacturing Corp., whose office is at 40 Withers St., Brooklyn, with plants in Brooklyn, N. Y., and Lincoln, N. J., announces the appointment of Courtney & Co., Dallas, Texas, as exclusive representatives for its line of buffs and polishing compounds.

Courtney & Co., well known in the southwestern territory as a manufacturer's representative for 20 years, will cover the following states: Texas, Oklahoma, Arkansas, Louisiana, New Mexico, and Colorado.

Charles H. Norton Passes

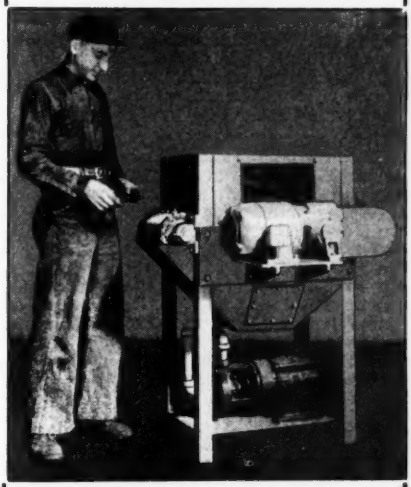
The death of Charles Hotchkiss Norton, 91, who had long been associated with Norton Co., Worcester, Mass., end-



Charles H. Norton

ed the career of an inventor whose genius is credited with having made one

FOR WASHING SMALL PARTS IN SMALL PLANTS



This small, compact INDUSTRIAL Washing Machine handles parts from 5/32" in diameter to 6¾" wide x 2¾" high.

The pump delivers a cold solvent solution at a pressure of approximately 25 pounds per sq. in. (A steam injector can be supplied for a heated alkali.)

This machine has a constant speed drive of 32 ft. per minute which gives a capacity of 16 sq. ft. of work per minute. Motors and pumps are mounted on machine.

Write for complete details.

INDUSTRIAL WASHING MACHINE CORP.

291 BURNET ST., NEW BRUNSWICK, N. J.

of the greatest contributions by any individual to American mass production methods. A native of Plainville, Mr. Norton died at his home, Sharpenhoe, Red Stone Hill.

Mr. Norton first became associated with Norton Co. in 1900 when the then Norton Emery Wheel Co. founded the Norton Grinding Co., with Mr. Norton as designer and chief engineer, to introduce his methods of cylindrical grinding, and to manufacture machinery of his invention and design. When Norton Grinding Co. was merged with Norton Co. in 1919, he became chief engineer for the machine division. He has not been actively associated with the company for a number of years because of his advanced age.

He was a member of the National Machine Tool Builders' Association, National Geographical Society, National Society for Constitutional Government and the Audubon Society. He was a director of the Plainville Trust Co. He was awarded the John Scott medal "for the invention of accurate grinding devices of high power" at the commencement exercises of the University of Pennsylvania, June 17, 1925. The honor marked world-wide recognition of his inventions.

Reichwein Promoted to Superintendent of Janette Manufacturing Company

Mr. John H. Reichwein has been promoted from Assistant Superintendent to Superintendent of Janette Manufacturing Company, 556 W. Monroe St., Chicago, Ill., manufacturer of electrical machinery.

Mr. Reichwein, who has been with the Janette Mfg. Company for the past eight years, was formerly Assistant Production Manager for the Roth Division of Century Electric Company.

F. L. LaQue Discusses Galvanic Corrosion

F. L. LaQue, of the Development and Research Division of The International Nickel Company, Inc., 67 Wall St., New York City, recently gave a talk under the title "Some Questions and Answers on Corrosion Processes" at the Annual Meeting of the Central Appalachian Section of the American Institute of Mining and Metallurgical Engineers, at Prichard Hotel, Huntington, W. Va.

Among the points Mr. LaQue attempted to clarify were: 1. What is corrosion?; 2. What is the generally accepted theory of corrosion?; 3. What are the most important factors in corrosion?; 4. What is galvanic corrosion and what are the most important controlling factors?; 5. What steps may be taken to minimize galvanic effects?; 6. How may galvanic effects be neutralized by cathodic protection, as by the use of zinc blocks, and where should these be placed?; 7. What materials are most useful in resisting attack by mine waters?

Claud S. Gordon Company Adds Robert A. Murdock to Indianapolis Staff

Mr. W. E. Ellsworth, Manager Indianapolis office, 31 E. Georgia St., of The Claud S. Gordon Company announces the addition to its staff of Robert A. Murdock, as service engineer.

Mr. Murdock brings to his new post an unusually capable background acquired in his past two and one-half years with the Jones and Laughlin Steel Corporation as instrument man. He was born in Pittsburgh and educated at Carnegie Tech. Now, with the Claud

S. Gordon Company, specialists since 1914 in the field of industrial temperature equipment and operation, material testing equipment, and allied products, enterprising and talented young Mr. Murdock plans to render the most outstanding service of his career.

Gordon headquarters are at 300 S. Wallace St., Chicago, Ill. Another branch office is located in Cleveland.

Floyd Todd Joins Quaker Chemical Staff

Mr. Floyd Todd has joined the laboratory staff of Quaker Chemical Products Corporation, Conshohocken, Pa., in a research capacity. His initial work will be in the field of metal corrosion.

Mr. Todd, who received his M.S. degree at Cornell University, has been connected in the past with the Atlantic Refining Company and Sharp & Dohme Company.

War Control Handbooks. Two new handbooks—one digesting all price and priority regulations now in effect and the other summarizing the controls on imports and exports—are now being issued by the N. Y. Journal of Commerce, 63 Park Row, New York City. The price is 0.25 each.

Every OPA price ceiling or rationing order and every WPB "L," "M" and "P" regulation is covered in the compact 32-page "War Controls Guide." Industries and commodities are listed alphabetically along with a brief digest of the various OPA and WPB regulations and amendments affecting each item. Over 2,100 individual rulings have been edited, weeded out, and indexed in the effort to present a quick, authoritative over-all picture of existing War Controls.

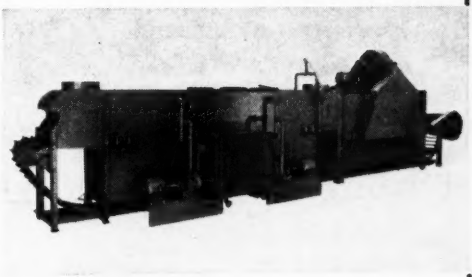
The new "Import-Export Control Index" lists all existing controls in imports and exports along with the shipping priority rating and licensing symbols assigned to the various commodities. The import section includes a complete breakdown of the much discussed WPB Order M-63 and an outline of the forms and information importers are required to furnish. Commodity numbers, general license ranges and shipping priority ratings are presented in the export section.

$50.00 War Bonds Now $37.50

ENGINEERED *for* SPEED

METAL WASHERS
DEGREASERS
PICKLERS
QUENCHERS

BLAKESLEE *engineered-for-you* washers and degreasers are *engineered for speed.* To insure your production, to guarantee clean products, and to meet the top production required by war needs, your problems are considered from every angle. Every factor is considered to give perfection in your washing and degreasing operation.



The above machine is a Blakeslee double tank, wash, rinse, blow-off and steam recirculatory air type dryer. The machine is designed especially for washing machine castings for a 24-hour day.

G. S. BLAKESLEE & CO.

NEW YORK CHICAGO TORONTO

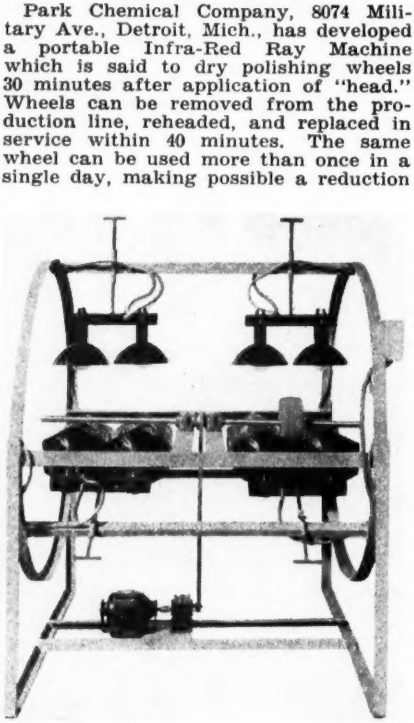
New PLANT EQUIPMENT AND Materials

Park Infra-Red Dryer for Polishing Wheels

Park Chemical Company, 8074 Military Ave., Detroit, Mich., has developed a portable Infra-Red Ray Machine which is said to dry polishing wheels 30 minutes after application of "head." Wheels can be removed from the production line, reheaded, and replaced in service within 40 minutes. The same wheel can be used more than once in a single day, making possible a reduction in wheel inventory. Wheels pass three lamps in each revolution. Lack of the required number of stock wheels will not prevent the finishing of rush jobs now, with the Park Dryer, at low initial and operating costs.

Lamps are adjustable to any distance from the wheels, and various diameter wheels can be mounted on the drying shaft, by use of special bushings. There are no wet spots on wheels, and even drying is said to be assured. Small floor space is required, as the unit is 54 in. square by 66 in. high, and the working height of the loading shaft is 42 in. from the floor.

The Park Infra-Red Dryer is equipped with 12 gold-plated reflector lamps, 240 watts, 115 volts each. The standard shaft on which the wheels are mounted during the drying operation is one inch in diameter. There are two control switches for adjustable lamps. The motor is 1/6 h.p., single phase, 60 cycle, 1,725 r.p.m. Speed reduction is 60 to 1. The working speed of shaft is approximately 12 r.p.m., but can be regulated to give other speeds if necessary. A 48-in. loading space on the main shaft of the unit is provided. The unit is furnished with casters for portability.



Park Infra-Red Dryer for Polishing Wheels

Kocour Analytical Set

An analytical set for chromic and sulfuric acid anodizing solutions to determine total and free acid has been placed on the market by the Kocour Co., 4724 S. Christiana Ave., Chicago, Ill. This control set enables anyone to rapidly determine the condition of a sulfuric or chromic acid anodizing solution. Anodizing solutions gradually build up in

aluminum salts and thereby decrease in efficiency. Best results and highest efficiency is obtained only when the solutions are properly controlled. The Kocour Analytical Set determines the total acid and the free acid content. With these factors known, the effective acid is readily calculated. Results given by the sets are direct so that an absolute minimum of calculations are required.

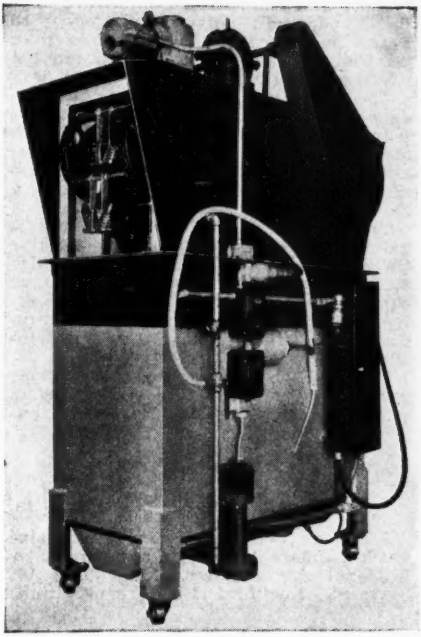
The Kocour Analytical Set consists of a well made wall cabinet fitted with hardware to hold the necessary glassware during use and storage. The glassware is of finest make, most of it is of special manufacture. The solutions are in easily handled bottles, clearly labeled, and so concentrated that very little is used in each test. Most solutions do not deterioriate but those that do can be used and correct results obtained. This insures dependable and economical operation at all times. Complete directions are supplied.

Phillips Fully-Automatic Portable Still

The necessity for full recovery of chlorinated solvents (used principally in vapor type degreasers) in industrial plants, brings a timely development by the Phillips Manufacturing Company, Dept. T., 340 W. Huron St., Chicago, Ill., of an electrically operated and controlled, fully-automatic, air-cooled, portable still and condenser.

The principal feature of these stills is that all heaters and controls are mounted integrally on the easily removed pot head, assuring easy cleaning and servicing, as well as easy access to the pot with no fixed fittings on the interior to trap solids.

In operation the still is plugged into a grounded circuit receptacle, and dirty solvent is then pumped or poured into the pot. A sealed float switch indicates by green pilot lamp when pot is full, and automatically energizes the heaters and starts the cooling fan on the condenser tower. When liquid level drops to a point just above the heater, the float switch cuts off the heater and pilot lamp until a new charge of dirty solvent is placed in the pot. When the oil residues reach a pre-determined specific



Phillips Fully-Automatic Portable Still

AUTOMATIC POLISHING & BUFFING MACHINES

Packer-Matic

THE PACKER MACHINE CO., MERIDEN, CONN., U. S. A.

Lower Your Finishing Room Costs

INCREASE PRODUCTION

Today's Efficient Method of VOLUME FINISHING

gravity and temperature, indicating a 98 to 99 per cent solvent recovery, the heater is de-energized, and a red pilot lamp signals the operator to dump the residue before again filling the pot.

The collector chamber of the condenser tower is fitted with a moisture trap to insure removal of water which may be in solution with dirty batches, and the clean solvent discharge pipe is at a level permitting draining into a standard drum lying on the floor.

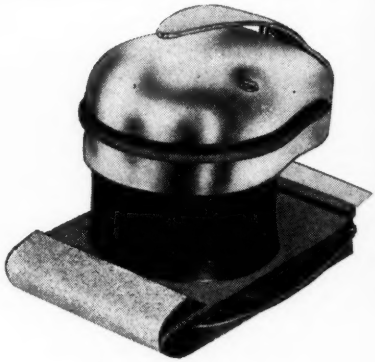
The Phillips Portable Still produces 15 gallons per hour, operating on single or three-phase, 220 or 440 volts, 60 cycles a.c., and is classified under maintenance equipment priority rules. Larger capacity stills in various sizes are also manufactured, operating under the same principles.

The unit is constructed to recover perchlorethylene and can be modified to recover carbon tetrachloride and trichlorethylene.

National "Mity-Midget"

A new development in small size block sanders has been announced by National Air Sanders, Inc., 21714 W. State St., Rockford, Ill. The new unit, named the "Mity-Midget," is hand size, 5½ in. long, 4¼ in. high and weighs only 3½ pounds.

Chief among the features of this new sander is the elimination of vibration which precludes fatigue. As such, it is said to be ideal for close fillet work and small surfaces as well as large areas.



National "Mity-Midget"

According to the manufacturer, actual time tests show that "Mity-Midget" cuts labor and abrasive costs up to 75 per cent over hand operations. It is equally good for metal or composition surfaces. The trigger starter fits the palm of the hand, permitting positive hair-line control.

Both wet and dry sanding is possible. The appliance is air operated, using five cubic feet on 50 lbs. pressure.

Anhydrous Sodium Metasilicate

The manufacture of anhydrous sodium metasilicate at its Chester, Pa.,

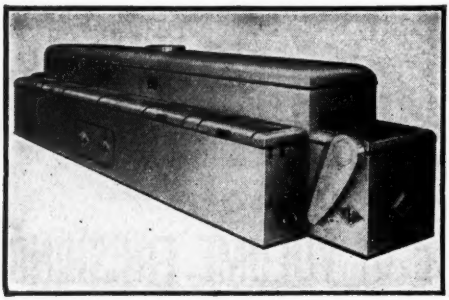
McKeon's

"Liquid Sulphur"

REMOVES COPPER PLATING

SAMPLE FREE

Sulphur Products Co., Greensburg, Pa.



HYDRO-FLOW
Industrial Washing Machines

Streamlined design. Hidden motors, pumps and pipes are easily assembled. Piping and nozzles located to insure thorough cleansing of all surfaces. Rugged and efficient pressure pump. Corrosion resistant spray nozzles—from mist to open stream. Monorail, Belt or Gravity type conveyors designed to carry any shape or size material. Variable speeds on conveyor drive synchronize production.

International Conveyor & Washer Corp.
Write for circular.
640 E. FORT ST. DETROIT, MICH.

and Anderson, Ind., plants has been announced by the Philadelphia Quartz Company, Philadelphia. This product is called Metso Anhydrous, latest member of their line of Metso Cleaners. It is a technical grade of anhydrous sodium metasilicate, Na_2SiO_3, without water of crystallization.

White and free-flowing, the anhydrous metasilicate is specially sized to reduce dustiness and to permit ready solubility. Of primary interest to fabricators of cleaning compounds for special purposes is its compatibility with soap, wetting agents, and other alkalis, such as caustic soda and phosphates of soda.

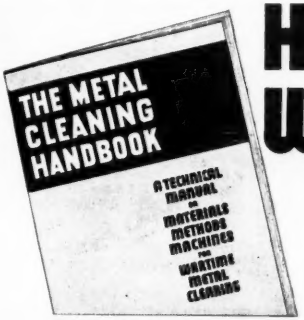
Commercial quantities are now being packed in wax lined barrels and fibre drums.

Westinghouse Porcelain Enameled High Bay Reflector

For general lighting of medium and low bay areas in foundries, machine shops, power plants, receiving and shipping departments, and similar industrial locations, a new porcelain enameled high bay reflector line is announced by the Westinghouse Electric & Mfg. Co., Lighting Division, Edgewater Park, Cleveland, Ohio.

Porcelain enameled reflector for high bay areas

This new line is designed for either incandescent or high intensity mercury



HOW TO CLEAN WHAT··AND WHY!

The First *Complete* Technical Manual on Metal Cleaning!

This new Magnus Handbook, now printing, covers the whole story on war time metal cleaning — the selection of the most suitable and satisfactory cleaning material, method and machine for each individual metal cleaning problem.

Nowhere else can you find under one cover the comprehensive and practical information at your command in this manual.

You'll need copies for every man in your plant who is concerned in any way with metal finishing operations.

RESERVE THEM NOW!

MAGNUS CHEMICAL COMPANY

Manufacturers of Cleaning Materials, Industrial Soaps, Metallic Soaps, Sulfonated Oils, Emulsifying Agents and Metal Working Lubricants.

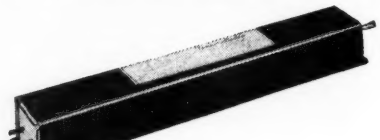
208 South Avenue **Garwood, N. J.**

Magnus CLEANERS

lamps and is available with either the locklite two-piece quick detachable construction or one-piece type for conduit or outlet box mounting. The multiple coat porcelain enameled reflecting surface is permanent, easily cleaned and has a reflectivity of 80 per cent.

Acme Fluorescent Lamp Ballast

Announcement has been made by the Acme Electric & Mfg. Co., Cuba, N. Y., that a new model F 100-25 lamp ballast



Acme Fluorescent Lamp Ballast

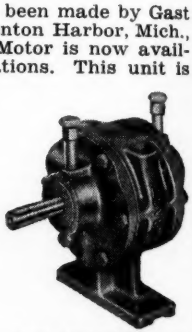
for four 100 watt fluorescent lamps is now in production and is available for use on industrial lighting orders or replacements carrying high priority ratings. Because the use of this unit will largely be in fixtures having their ultimate use in war production plants, the electrical characteristics correspond to the majority of such applications.

The manufacturers claim that the F 100-25, four lamp ballast is designed to provide equalized and balanced secondary voltage for each lamp. Providing starters and switches are in good order, this would assure all four lamps of the unit lighting at the same time. There is said to be no drag, delay, or flashing.

The core and coil elements of this ballast are said to be impregnated and compounded to minimize normal resonant vibration, thus reducing the second level to a negligible point.

Gast Explosion-Proof Rotary Air Motor

Announcement has been made by Gast Mfg. Corporation, Benton Harbor, Mich., that its Rotary Air Motor is now available for new applications. This unit is declared especially suitable for locations where compressed air is available and where explosion-proof equipment is essential. It is particularly applicable to war production jobs such as driving mixing equipment in munitions plants, and so on.



Gast Explosion-Proof Rotary Air Motor

Because the basic design of the Gast Air Motor employs the same rotary principle as Gast Vacuum Pumps and

BLACK-MAGIC

Permanent blacking in "ONE BATH"

"375,000 Machine Gun Magazines without a single rejection" is the record of one large company using BLACK MAGIC

Government approved!

Write for portfolio of complete information.

Mitchell-Bradford Chemical Co.
BRIDGEPORT, CONN.

NALCO DRITHERM
CARBON FILAMENT LAMPS
Best For Infra-Red Ray Drying

Nalco Dritherm Lamps are the carbon filament type...proved for years in therapeutic and industrial practice as providing maximum emanation of infra-red ray within the desirable penetration band. Made only by—

NORTH AMERICAN ELECTRIC LAMP CO.
1020 Tyler Street **St. Louis, Mo.**

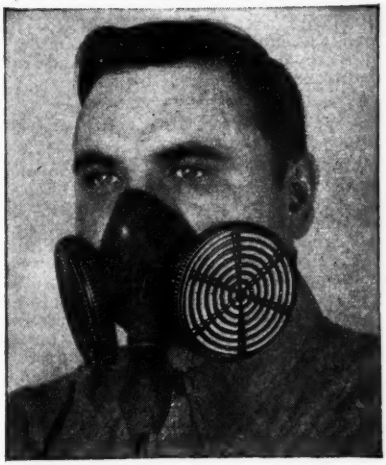
Compressors, it is stated that this motor offers the following desirable features: No reciprocating parts or springs, automatic take-up for wear, low maintenance, positive starting in any position, and exceptional compactness for power developed.

Gast Rotary Air Motors deliver from 1/20 to 1 h.p. They are fitted with ball bearings and all parts are accurately ground. Self adjusting shaft seals are used instead of packing.

M.S.A. Comfo Dust Respirator

In order to save metal for war production, the M.S.A. Comfo Dust Respirator has been re-designed with filter cases of black plastic, according to a recent announcement by the Mine Safety Appliances Company, Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

Approved by the U. S. Bureau of Mines, this well-known respirator is said to now offer better appearance plus less resistance to air flow. The new filter container units are thinner, with rounded edges, permitting even better sidewise and downward vision. The redesigned plastic filter cases have high impact strength with no electrical con-



M.S.A. Comfo Dust Respirator

ductivity. They are not affected by perspiration.

Retaining every Comfo advantage of safety and comfort in dust protection, the field-proved plastic model has twin

MARSCHKE
QUALITY
GRINDERS
AND
BUFFERS

THE MARSCHKE LINE includes Swing Frame Buffers — for large surfaces and heavy work pieces— and a variety of pedestal type machines with direct motor drive and *multiple* wheel speeds. Whatever your buffing requirement, there's a fine quality Marschke built to save you money. You will appreciate its DEPENDABLE DURABILITY.

Marschke Selective Speed Buffer, built for hard continuous service.

The Simplified Swing Frame Multiple-Speed Marschke Buffer with "finger-tip" control!

Write for Catalog to—

VONNEGUT MOULDER CORP.
1845 Madison Ave., Indianapolis, Ind.

side-placed replaceable filters of unusually large area. The unit is easy to clean and maintain and is available in types to meet various dust and mist conditions.

Alcofoam

Alcofoam, the latest foam development to safeguard the rapidly expanding alcohol industry against fire, has been placed on the market by American-La France-Foamite Corporation, Elmira, N. Y. Produced from Alcofoam powder, it forms a smothering blanket that snuffs out flames in alcohols, ketones, esters, ethers, and other such flammable liquids. It is also said to be dependably effective on petroleum fires.

Poured into any single powder generator, and carried through a water stream, Alcofoam powder generates a foam which floats on the lightest liquid surface. Applied at time of fire through fixed connections on storage tanks, or directed through hose and nozzle, it is said to completely cut off the supply of oxygen necessary to support combustion.

Alcofoam forms an airtight, heat resisting, tenacious blanket made up of millions of minute, tough, durable bubbles containing carbon dioxide gas. It is said to stay in place despite fire draft, preventing reignition or reflash. It coats and insulates any burning surface, liquid or solid, vertical or horizontal, according to the manufacturer, and is approved by both Underwriters' and Factory Mutual Laboratories.

Alcofoam Powder is readily poured into any single powder generator

West Bend Model L "Weld-Bilt" Heavy Duty Hydraulic Lift Truck

West Bend Equipment Corp., West Bend, Wis., announces the addition of

SPECIFICATIONS!

+

PLUS

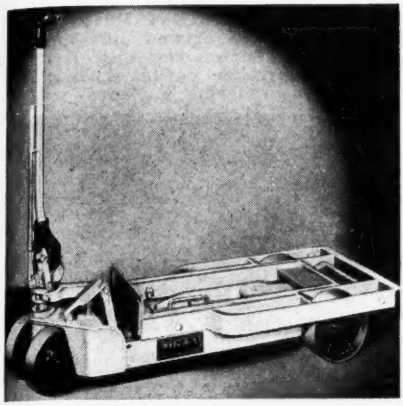
Adaptation of formulae to the individual requirements of busy war contractors.

Within specification limits there are many possibilities of improvement in speed, workability, and freedom from rejects.

This PLUS factor is worth considering. We'd like to tell you more about it.

The Varnish Products Co.
Cleveland, Ohio

BOYL-COTE
A New Development
INFORMATION ON REQUEST
INDUSTRIAL CHEMICAL PRODUCTS CO.
DETROIT
Milwaukee **Fort Wayne**



West Bend Model L "Weld-Bilt" Heavy Duty Hydraulic Lift Truck

a 10,000-lb. capacity truck, designated as the Model L, to its line of "Weld-Bilt" hydraulic lift trucks. Designed for easy mobility and unusual efficiency in handling extremely heavy loads, this model is said to have all the standard "Weld-Bilt" features, including a shockproof horizontally mounted hydraulic unit, which is interchangeable and can be easily removed without special tools, thus permitting easy replacement after years of service.

Made in both narrow and wide platform sizes, the Model L truck has frames, wheels, and lifting mechanism of extra heavy construction. The frames which are made of steel, are completely arc welded and heavily crossbraced for extra strength and rigidity. All moving parts of the truck are equipped with ball or roller bearings.

The West Bend Model L Weld-Bilt Heavy Duty Hydraulic Lift Truck is available in a wide variety of sizes, heights, and widths.

Osborn "Sibot" Brushes

Brushes that look like discs with two square corners and rotate like a spinning coin are being produced by the Osborn Manufacturing Company, 5401 Hamilton Ave., Cleveland, Ohio, for service in industry to remove rust, scale, rubber, burrs, sharp corners, dirt and chips from metal holes, cavities and recesses. These brushes, to be known as "Sibot" Brushes, will clean both the

LOOK! next month for Sterling's

NEW SANDER

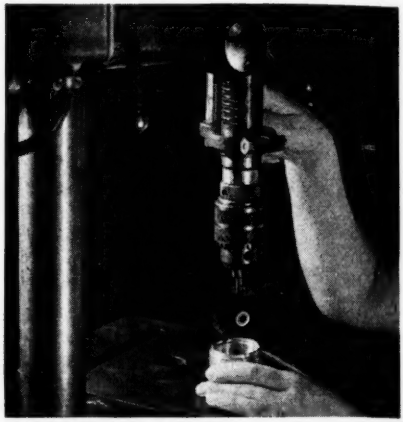
Outstanding Development in Its Field.
Speeds War Production.

STERLING TOOL PRODUCTS CO.
375 East Ohio Street • Chicago, Illinois

bottoms and side walls in the cavities of various machined, stamped, cast and forged parts in one operation.

"While the most important feature of the Osborn Sibot Brush is its ability to contact both the side wall and the bottom at the same time, its use is particularly applicable to fast methods of production and to relatively easy adaptation to existing production equipment," according to R. O. Peterson, manager of the Technical Department of the company.

The fixtures for operating are usually very simple. The brushes may be inserted into the chuck of an ordinary drill press, for example. Peterson cited a case record of a company that is using the brushes to clean fuse parts. "It was possible for this company to eliminate several tedious, skill-demanding, hand operations with dental burrs, and substitute one fast brushing operation," he said. "This has resulted in the release of floor space and operators for other work. Such a result is of fundamental importance during the national emergency where high productivity with existing facilities is required. Furthermore, the brush eliminated practically all rejections due to burrs around the holes which intersect the cavities in the fuse parts."



Osborn Sibot Brushes mounted on a chuck for cleaning cavity in metal fuse part

The construction of the Osborn Sibot Brush is such that no metal parts extend beyond its working surface, which is said to make it impossible to injure work if proper conditions exist. Osborn Sibot Brushes are made of wire in two ringlock sections with a metal shank in between.

StaSafe Eye Shield for Women

A new type lightweight eye shield to be known as "StaSafe" has been placed on the market by Standard Safety Equipment Company, 232 W. Ontario St., Chicago, Ill. This eye shield, in addition to giving eye protection, has a quarter dome head shield made of fibre

-for Fast-Finishing

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For nearly forty years we have been producers and refiners of abrasive grains, serving the industry with a strictly quality product for all particular abrasive applications.
Accurately Graded — Thoroughly Cleaned — Greater Capillarity — Longer Wear.

Send for trial lot—FREE!

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THE HAMILTON EMERY & CORUNDUM CO.

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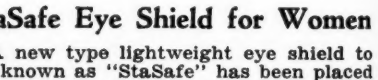
BETTER PLATING, LESS COST!
"MGC" ELECTROPLATING EQUIPMENT
Write for Interesting Details TODAY!
MOTOR GENERATOR CORP., HOBART SQ. PF-122 TROY, OHIO



which provides a certain amount of hair protection for women workers.

The objection to wearing some type of hair guard is said to be overcome by the quarter dome arrangement on the Sta-

StaSafe Eye Shield for Women

Safe Eye Shield for women. The headgear can also be supplied with a leather sweatband or cellulose sponge. The unit is also available without the quarter dome protection. A convenient feature of the StaSafe Eye Shield is that the entire front can be raised or lowered.

Cyclodiene Hydrocarbon Degreasing Solvent

For metals, ferrous and non-ferrous, as well as many other materials, Cyclodiene Hydrocarbon is recommended by Technical Processes Division of Colonial Alloys Company, Philadelphia, Pa., as a high speed solvent cleaner. The work is dipped in open wood or steel tanks in which the solvent is kept at room temperature—the work comes out thoroughly degreased and a rust inhibitive thin protective film remains on the work for about 20 minutes before complete evaporation. It is claimed that high speed evaporation can be accomplished by dipping into hot water or "Methanated Hydrocarbon" which operates about as fast as carbon tetrachloride. Oven drying provides quicker evaporation.

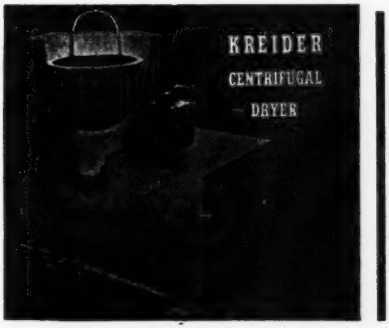
According to standards of the Bureau of Explosives, it is claimed that Cyclodiene Hydrocarbon is considered non-flammable and non-explosive, as well as non-corrosive and rust inhibitive. Venting is desirable but not absolutely essential. The manufacturers claim this material can serve as a cleaner for products to be plated, painted, Parkerized, anodized, or otherwise finished.

It is further claimed that re-distillation yields not less than 90 per cent recovery at 375 to 410 deg. F. Vaporization at room temperature is normal and not excessive.

Jo-Lar Porcelain Renew

Although new in name, Jo-Lar is not an entirely new product. For centuries the basic formula has been used in

CUT DRYING TIME...USE A



ON YOUR PLATED PARTS

Here's a modern, high speed drying outfit that will give you fast, low-cost drying and, at the same time, improve plating quality. Sturdy, simple design. All steel, welded construction. Controls include foot brake and reversing drum. V-belt drive; anti-friction bearings. Auxiliary heating unit available.

Write for complete information and prices.

DELLINGER MFG. CO., 729 N. Prince St., Lancaster, Pa.

For a real good polishing job use

KEYSTONE EMERY

TURKISH — NAXOS — AMERICAN

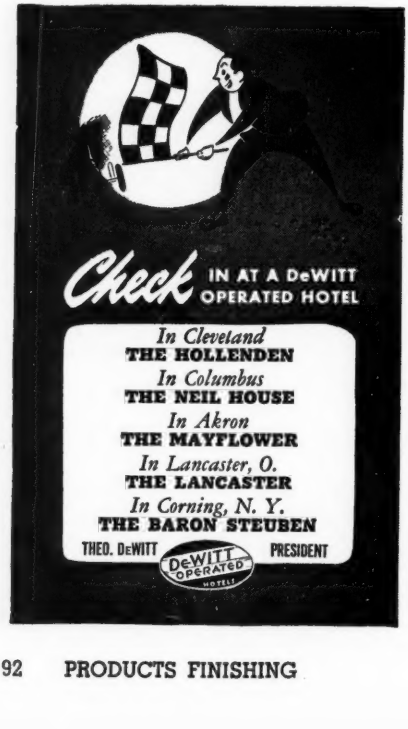
KEYSTONE EMERY MILLS *Write for Sample* 4316 Paul St., Phila., Pa.

China for repairing their famous porcelains. For 20 years it was produced by Captain John Larson of Chicago under the name of Grip Enamel Cement. It is now being marketed in improved form by the Johnson Products Company, 507 Fifth Ave., New York City. According to the manufacturer, it may be used to conceal chips, cracks, or scratches or to permanently repair anything of porcelain, china, glass plastic, enamel, ceramic, or vitreous ware.

Jo-Lar Porcelain Renew is said to conceal the damage and bond permanently with the base in a perfect porcelain finish. According to the manufacturer, it is a pure Frigidaire white and it stays white. It is said to be waterproof, alcohol proof, gasoline proof, and acid proof and will not crack, craze, check, or shrink.

Jo-Lar No. 1 is a cement filler. It may be used to join broken pieces; to fill cavities and chipped places; to cement felt, leather, rubber, glass, and so forth, to wood, porcelain, stone, metal, and other smooth surfaces.

Jo-Lar No. 2 is a porcelain glaze. It may be used for a finish over the cement and can be fused into a solid piece of enamel. It may also be used directly over slight scratches or shallow chips.



"Hercules" Curved Line Type Holder

A holder employing curved line type for use in marking metal ordnance parts having limited areas for such purposes

"Hercules" Curved Line Type Holder

is now being produced by the Arcomark Corp., 9 Morrell St., Elizabeth, N. J. The holder, which is designated as the "Hercules" Curved Line Type Holder, is made from a single piece of shock-resisting alloy tool steel and is furnished with either press shank or shank to fit the hand for striking with a hammer.

A steel clip holds the interchangeable type of the holder in place, the type

Modernized . . Beautified . .

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being readily interchanged by simple thumb pressure on the clip. Each piece of type is of segment shape and has the "Hercules" heavy shoulder feature to provide increased strength. All characters are engraved in an open and clear Gothic style with a strong bevel, and are tapered to face for maximum strength and to enable user to readily locate characters where desired in stamping.

The Hercules Curved Line Type Holder is available with any desired curvature and capacity. By easy insertion of blank spacers, less than capacity marking is said to be possible.

American Steel Shop Boxes

American Metal Works, Inc., 1519 Germantown Ave., Philadelphia, Pa., is now marketing a line of steel boxes for use in the handling and storage of parts in the plant. The line consists of four styles of boxes: namely, Style 100 taper pans, Style 400 straight side shop boxes, Style 500 stacking bins, and Style 600 stacking boxes.

The Style 100 taper pan is of one-piece, all-welded construction, with hook handle at each end, and is designed so as to nest perfectly when empty. The Style 400 straight side shop box has a rigid handle and hook holes at each end and is said to be excellent for shop use where stacking feature is not required.

The Style 500 stacking bin, it is claimed, is particularly useful for the storage and handling of small parts. The bin is designed so that when stacked contents are readily accessible. The Style 600 stacking box is an ideal all-purpose box of sturdy all-welded construction. Heavy skids act as a positive stacking lock and reinforce box at point of maximum wear.

Locker Room Safety — Steel Locker Conservation Poster. In the interest of safety and conservation, the Penn Metal Corporation of Penna., 36 Oregon Ave., Philadelphia, Pa., is now issuing a poster in red and black, size 19 in. by 25 in., which emphasizes the importance of proper use and care of steel lockers. It is important that steel locker installations be kept in good condition for the duration, due to the fact that new steel lockers will not be available and repair parts difficult to get.

The poster is offered without charge to all those who request it.

Opportunity Section

FOR SALE

Equipment for Black Oxide Finishing (Houghto-black, etc.) consisting of Gas-Fired Tanks, Heaters, Controls, Dipping Baskets, Vapor Suction System; all practically new, available immediately.

Write Box 10, PRODUCTS FINISHING
431 Main Street Cincinnati, Ohio

THIS Opportunity Section is available for classified advertisements featuring equipment, employment, business opportunities, etc., in the industries devoted to the cleaning, plating, polishing and finishing of metals. For advertising rates and other information address:

PRODUCTS FINISHING

431 Main Street • Cincinnati, Ohio

FOR YOUR Catalog LIBRARY

To obtain copies of the catalogs listed here, indicate on the coupon the number of the item in which you are interested and mail as directed.

1. Sturdy-Bilt "Simplex" Metal Parts Cleaner
The Sturdy-Bilt Equipment Corp., Dept. P-11, West Allis, Wis., is now issuing a folder describing the features of Sturdy-Bilt "Simplex" metal parts cleaning equipment.

2. Upsy Drum Loading Truck
A six-page folder devoted to a description and illustration of a one-man truck is now being issued by the American Pulley Company, 4200 Wissahickon Ave., Philadelphia, Pennsylvania.

3. Metal Cleaning Equipment
A four-page folder which illustrates and describes a well-rounded line of equipment for cleaning war products such as cartridges, gun barrels, shells and similar products is now being issued by the Alvey-Ferguson Company, 162 Disney St., Cincinnati, Ohio.

4. Dresinate for Extra-Action Metal-Cleaning Compounds
The Hercules Powder Company, Inc., Delaware Trust Bldg., Wilmington, Del., is now issuing an eight-page catalog, telling how the Dresinate method of metal cleaning will help prevent cleaning baths from becoming bottlenecks in the production line.

5. Centrifugal Compressors
A 20-page catalog, which illustrates and describes Design 9 Centrifugal Compressors for application wherever blowers for small capacity work are required, is now being issued by the B. F. Sturtevant Company, 16 Damon St., Hyde Park, Boston, Massachusetts.

6. Keystone Industrial Brush Catalog
Keystone Carbon Co., Inc., St. Marys, Pa., is now issuing a 24-page catalog describing slip ring, motor and generator brushes, metal graphite and carbon products.

7. Metal Parts Cleaning Equipment
Colt Autosan Metal Parts Cleaning Equipment is described in a 12-page catalog now being issued by Colt's Patent Fire Arms Mfg. Company, 1933 Van Dyke Ave., Hartford, Connecticut.

8. Burring with the Lea Method
An eight-page bulletin covering the Lea method of burring is now being distributed by Lea Manufacturing Co., 22 Cherry St., Waterbury, Connecticut.

9. Shell Cleaning with DuBoy Products
A data sheet describing the soaker tank method with Actex 200, the solvent method with Actusol, and the industrial washing machine method with Actex 200 is now being distributed by The DuBois Company, 1120 W. Front St., Cincinnati, Ohio.

10. Lixol Metal Cleaner
A solvent emulsion-type metal cleaner known as "Lixol" is described in a booklet which is now being issued by Cowles Detergent Company, 7016 Euclid Ave., Cleveland, Ohio.